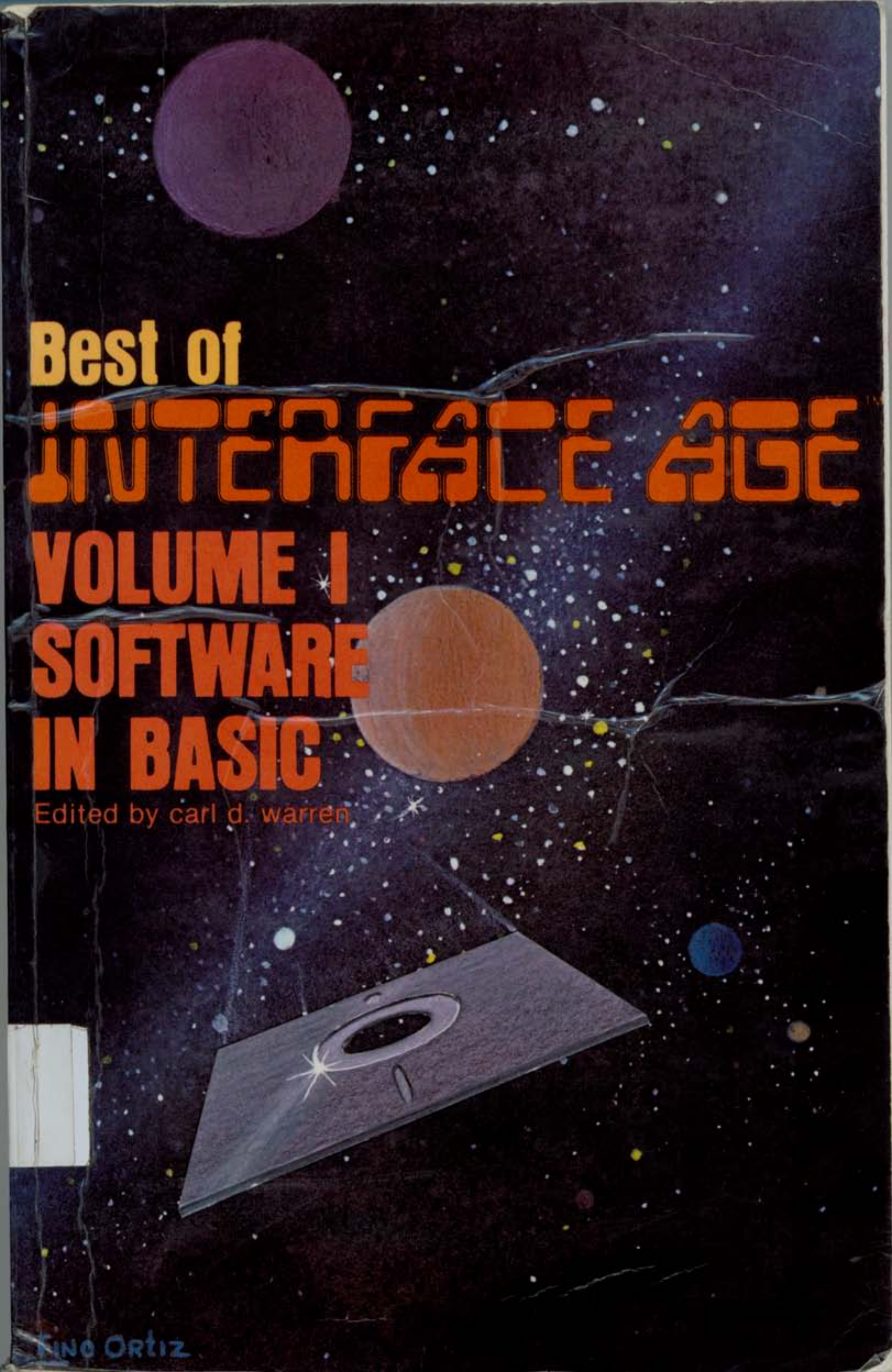


Best of INTERFACE AGE™
VOLUME I
SOFTWARE IN BASIC

Edited by carl d. warren

Best of Interface Age

Volume 1: Software in BASIC

Best of Interface Age

Volume 1: Software in BASIC

Carl D. Warren
Editor-in-Chief

dilithium Press
Beaverton, Oregon

©Copyright, Interface Age, 1979

10 9 8 7 6 5 4 3

All rights reserved. No part of this book may be reproduced in any form or by any means without permission in writing from the publishers, with the following two exceptions: any material may be copied or transcribed for the non-profit use of the purchaser; and material (not to exceed 300 words and one figure) may be quoted in published reviews of this book.

ISBN: 0-918398-36-3
Library of Congress catalog card number: 79-67462

Printed in the United States of America.

dilithium Press
11000 SW 11th St.
Beaverton, Oregon 97005

Preface

Several months ago, it became apparent that we should give serious thought to creating a "best of" series from the pages of *Interface Age*. The idea seemed like it would not present a major problem at first, until we looked at the mountain of material we had available. The quantity wasn't the only problem. The decision had to be made on what was best, so it could be included in the reprint series.

After careful consideration, with close attention being paid to readers' letters, the decision was made to create a "best of" series of *Interface Age* Classics. What this meant was that rather than to create a huge, difficult to use book of just about everything, we are printing the classic software pieces and the ones that many readers said they would like to see.

The four reprinted articles that you find in this volume are those classics. Furthermore, they represent several different programming techniques. At the same time, they provide the reader with some of the most useful software ever created.

Chapter four, "The Great Experiment," offers the one piece of software that has been requested more than any other: the complete source listing of Uiterwyk's 4K BASIC. It is an absolute classic. The source code was released into the public domain by Mr. Uiterwyk for this software volume, so students of software could achieve maximum benefit from its use. For this, we at *Interface Age* are extremely grateful.

My staff and I are quite convinced that everyone who makes use of this first volume will find it invaluable in making better use of their systems.

Volume 2 of this series is made up of additional general purpose software from some of the *Interface Age* authors you have enjoyed over the past few years. Volumes 3 and 4 are dedicated specifically toward the small businessman. These two volumes contain more business software than any book currently available today.

To round out this current "best of" series, Volume 5, *Best of Interface Age—Things to Think About*, contains those articles for the futuristic thinker and gadgeteer. This volume contains reprints from Roger Garret's famous "Inventor's Sketchpad." Also included are short and useful software tips, along with some handy hardware articles.

Interface Age has always been known as the leader in the publication of important and useful software and ideas. We feel that the publication of this "best of" series will further enhance our leadership and provide you with hundreds of hours of enjoyment.

carl warren
editor-in-chief

Acknowledgment

When a reprint series is created, it is of utmost importance to thank the authors whose works are being reprinted. We gladly extend our appreciation to them. We also thank all those authors that contributed articles over the past forty-plus issues, and the readers that have made us such a success.

Robert S. Jones
Publisher

Table of Contents

Chapter 1 Lawrence Livermore 8080 BASIC 1
by Jerry Barber, Royce Eckard, John Dickenson, David Mead, and E. R. Fisher
Original publication date: December 1976, January, February, and March 1977

Chapter 2 Dr. Wang's Palo Alto TINY BASIC 139
by Roger Rauskolb
Original publication date: December 1976

Chapter 3 National's TINY BASIC—NIBL 171
by Phil Roybal and Mark Alexander
Original publication date: December 1976, January 1977

Chapter 4 The Great Experiment—Floppy ROM™ # 1 Robert Uiterwyk's 6800 4K BASIC 229
by Bill Turner and William Blomgren
Original publication date: May, July 1977

Appendix A General Software Index 301
A comprehensive index of general purpose software printed in *Interface Age* since January, 1977

Appendix B Available Back Issues 311
A list of all the back issues that are still available, and how to obtain them.

Index 313

Chapter 1

Lawrence Livermore Laboratories 8080 Basic Interpreter

by Jerry Barber, Royce Eckard John Dickenson, David Mead and E. R. Fisher

The year 1976 saw a number of accomplishments to the microcomputer world, which was still very much in its infancy. The most important developments were with BASIC interpreters being made available to the micro user.

One such BASIC, was the 8080 version developed at the University of Idaho by John Dickenson, Jerry Barber, and John Teeter; under a contract with the Lawrence Livermore Laboratory. The floating point package was developed by David Mead, modified by Hal Brand and Frank Olken.

The entire project, including the course listing of the intérpreter was documented in the December 76, January 77, February 77, and March 77 issues of Interface Age magazine.

Because BASIC is still considered the most important language in the microcomputer industry, and also due to the continuing interest in the LLL version, we have re-published it here in its entirety.

STORAGE REQUIREMENTS

The BASIC interpreter consists of a 5K-byte-PROM resident interpreter used for program generation and debug was configured to operate with the MCS-8080 microprocessor.

The goal in developing the 8080 BASIC was to provide a high-level, easy-to-use conversational language for performing both control and computation functions in the MCS-8080 microprocessor. To minimize system memory size and cost, the interpreter was constrained to fit into 5K bytes. It was necessary, therefore, to limit the commands to those considered the most useful in microprocessor applications.

MATH OPERATOR EXECUTION TIMES

Average execution times of the four basic math operators are as follows:

Operation	**Execution time on 8080 (m sec)**
ADD	2.4 m sec
SUBTRACT	2.4 m sec
MULTIPLY	5.4 m sec
DIVIDE	7.0 m sec

BASIC INTERPRETER LANGUAGE GRAMMAR

COMMANDS—Six BASIC interpreter commands are provided. These commands are:

RUN	Begins program execution
SCR	Clears program from memory
LIST	Lists ASCII program in memory
PLST	Punches paper-tape copy of program
PTAPE	Reads paper-tape copy of program using high-speed reader
CNTRL S	Interrupts program during execution

The LIST and PLST commands can be followed by one or two line numbers to indicate that only a part of the program is to be listed. If one line number follows the command, the program is listed from that line number to the end of the program. If two line numbers (separated by a comma) follow the command, the listing begins at the first line number and ends at the second.

When a command is completed, READY will be typed on the teletype. Once initialized by a command, a process will normally go to completion. However, if you wish to interrupt an executing program or a listing, simply strike CNTRL S and the process will terminate and a READY message will be typed.

STATEMENTS—Each statement line begins with a line number, which must be an integer between 0 and 32767. Statements can be entered in any order, but they will be executed in numerical order. All blanks are ignored. The following types of statements are allowed:

REM—Indicates a remark (comment). The system deletes blanks from all character strings that are not enclosed in quotes ("). Therefore, it is suggested that characters following the REM key word be enclosed in quotes.

END—Indicates the end of a program. The program stops when it gets to the END statement. All programs must end with END.

STOP—Stops the program. This statement is used when the program needs to be stopped other than at the end of the program text.

GOTO—Transfers program control to specified statement line number. This statement is used to loop or jump unconditionally within a program. Program execution continues from new statement.

DIM—Declares an array. Only one-dimensional arrays with an integer constant number of elements are allowed. An array with N elements uses indexes 0 and N-1. All array locations are set to zero. No check is made on subscripts to ensure that they are within the declared array. An array variable must be a single letter.

LET—Indicates an assignment statement (Addition, subtraction, multiplication, division, or special function may be used). The LET statement is used to assign a value to a variable. Non-array variables can be either a single letter or a letter followed by a digit. It is possible to have an array and a non-array variable with the same name. The general form of the LET statement is:

line number LET identifier = expression,

where *identifier* is either a subscripted array element or a non-array variable or function and *expression* is a unary or binary expression. The expression will be one of the following ten types:

variable
– variable
variable + variable
variable – variable
– variable + variable
– variable – variable
variable * variable
– variable * variable
variable / variable
– variable / variable,

where *variable* is an identifier, function, or number. The subscript of an array can also be an expression.

IF—Condition statement which transfers to specified line number statement if the condition of the expression is met. It has the form: line number IF expression relation expression THEN transfer line number. The possible relations are:

Equal	=
Greater than	>
Less than	<
Greater than or equal	>= =<
Less than or equal	<= =<
Not equal	<> ><

If the relation between the two expressions is true then the program transfers to the line number, otherwise it continues sequentially.

INPUT—This command allows numerical data to be input via the teletype. The general form is:

```
Line number INPUT identifier list,
```

where an *identifier list* is a sequence of identifiers separated by commas. There is no comma after the last identifier so, if only one identifier is present, no comma is needed. When an INPUT statement is executed, a colon (:) is output to the teletype to indicate that data are expected. The data are entered as numbers separated by commas. If fewer data are entered than expected, another colon is output to the teletype, indicating again that data are expected. For example, where

```
50 INPUT I,J,K,P
```

is executed, a colon is output to the teletype. Then, if only 3 numerical values are entered, another colon will be output to indicate that more data are expected; e.g.,

```
:4,4,6.2 C/R
:10.3 C/R
```

where C/R is the carriage-return key. If an error is made in the input-data line, an error message is issued and the entire line of data must be reentered. If, for the above example,

```
:4,4,6M2,10.3 C/R
```

is entered, the system will respond:

```
INPUT ERROR, TRY AGAIN
:
```

At this time, the proper response would be

```
4,4,6.2,10.3 C/R.
```

PRINT—This command allows numerical data and character strings to be printed on the teletype. Two types of print items are legal in the print statement: character strings enclosed in quotes (") and expressions. These items are separated by either a comma or a semicolon. If print items are separated by a comma, a skip occurs to the next pre-formatted field before printing of the item following the comma begins. The pre-formatted fields begin at columns 1, 14, 27, 40, and 52. If print items are separated by a semicolon, no skip occurs. If a semicolon or comma is the last character on a print statement line, the appropriate formatting occurs and the carriage-return-line feed is suppressed. A print statement of the form

```
50 PRINT
```

will generate a carriage-return-line feed. Thus the two lines below

```
50 PRINT "INPUT A NUMBER";
60 INPUT A
```

will result in the following output:

```
INPUT A NUMBER:
```

FOR—Causes program to iterate through a loop a designated number of times.

NEXT—Signals end of loop at which point the computer adds the step value to the variable and checks to see if the variable is still less than the terminal value.

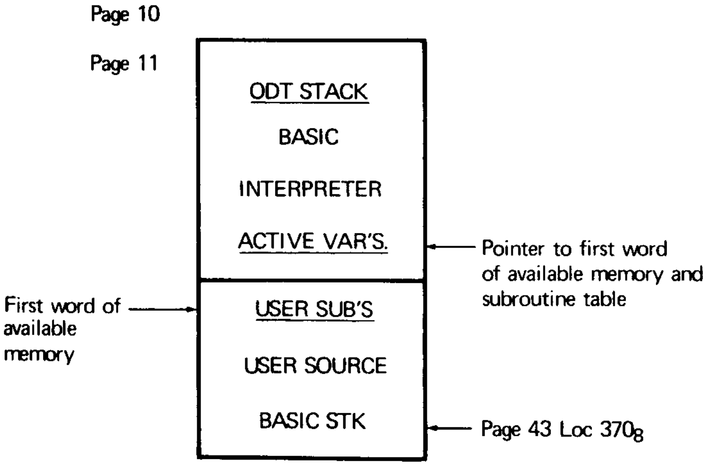
GOSUB—Transfer control to a subroutine that begins at specified line number.

RETURN—Returns control to the next sequential line after the last GOSUB statement executed. A return statement executed before GOSUB is equivalent to a STOP statement.

CALL—Calls user-written assembly-language routines of the form

CALL (N,A,B,. . .),

where N is a subroutine number from 0-254 and A, B,. . . are parameters. The parameters can be constants, variables, or expressions. However, if variables and constants or expressions are inter-mixed, all variables should have been referenced before the CALL statement. Otherwise, the space reserved for newly referenced variables may overwrite the results of constants and expressions. A memory map of one configuration of the system is shown below.



The subroutine table contains 3-byte entries for each subroutine. The table directly follows the pointer to the first word of available memory (FWAM) and must end with a octal 377. A sample table and its subroutines is shown below:

```
ORG 16612Q
DWSUBEND        ;Define FWAM
DB 1            ;Subroutine #1
DW SUB1         ;Starting add of subroutine
                #1
DB 4            ;Subroutine #4
```

```
DW SUB4          ;Starting add of subroutine
                 #4
DB 5             ;Subroutine #5
DW SUB5          ;Starting add of subroutine
                 #5
DB 2             ;Subroutine #2
DB SUB2          ;etc.
DB 377Q          ;end of subroutine table
SUB1:↓           ;Subroutine #1
      RET
SUB5:↓           ;Subroutine #5
      RET
      •
      •
      •
      RET        ;Retain last subroutine
SUBEND EQU$      ;FWAM
```

Addresses to passed parameters are stored on the stack. The user must know how many parameters were passed to the subroutine. These must be taken off the stack before RET is executed. Addresses are stored last parameter first on the stack. Thus, on entry to a subroutine, the first POP instruction will recover the address to the last parameter in the call list. The next will recover the next to last, etc.

Each scalar variable passed results in the address to the first byte of a four-byte block of memory. Each array element passes the address to the first byte of a (N-M) x four-byte memory block, where N is the number of elements given the array in the DIM STMT and M is the array subscript in the CALL STMT.

For passed parameters to be handled in expressions within BASIC, they must be in the proper floating-point format.

FUNCTIONS—Two special functions not found in most BASIC codes are available to input or output data through Intel 8080 port numbers. These functions are;

GET (X) = READ 8080 INPUT PORT X.
PUT (Y) = OUTPUT A BYTE OF DATA TO OUTPUT PORT Y.

The function GET allows input from a port and the function PUT allows output to a port. Their general forms are:

GET (expression).
PUT (expression).

The function GET may appear in statements in a position that implies that a numerical value is used. The function PUT may appear in statements in a position that implies that a numerical value will be stored or saved. This is because GET inputs a number and PUT outputs a number. For example, while

LET PUT(I) = GET(J) is valid
LET GET(I) = PUT(J) is invalid.

These functions send or receive one byte of data, which in BASIC is treated as a number from 0 to 255.

VARIABLES—Single characters A→Z
Single character followed by a signal decimal digit

NUMBERS—Numbers in a program statement or input via the teletype are handled with a floating-point package provided by LLL. Numbers can have any of the following forms:

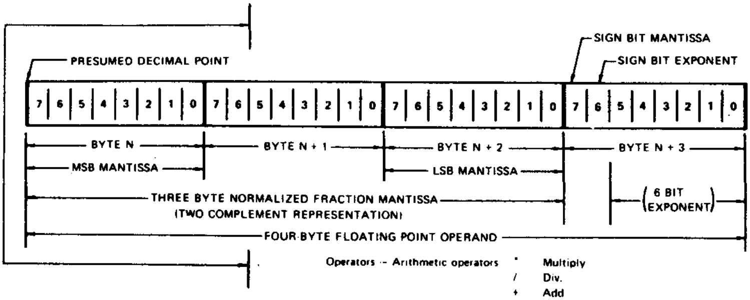
4 ±4. .123
4. ±4.0 ±.123
4.0 1.23 0.123
±4 ±1.23 ±0.123

and the user may add an exponent to any of the above forms using the letter E to indicate powers of 10. The forms of the exponent are:

E±1 E±15
E 1 E 15
E 1 E 15

The numbers are stored with seven-digit accuracy; therefore, seven significant figures can be entered. The smallest and largest numbers are ±2.71051E-20 and ±9.22337E18.

Floating point numbers are expressed as a 32 bit operand consisting of a 24 bit normalized fractional mantissa in standard two's complement representation and a 6 bit exponent also is standard two's complement representation with a range of −64 to +63. The exponent byte also includes the exponent sign bit and mantissa sign bit. The floating point number format is as shown in the following:



Operators -- Arithmetic operators	*	Multiply
	/	Div.
	+	Add
	-	Sub.
Relational operators	=	Equal
	<>	Not Equal
	<	Less Than
	>	Greater Than
	<=	Less Than or Equal
	=>	Greater Than or Equal

INTERPRETER OPERATION

INITIALIZATION—The BASIC interpreter is presently configured so that it is located in memory pages 11_8 to 34_8. The starting address is page 17_8, location 0. This address begins an initialization sequence that allows the user to begin with a clear memory. However, to avoid the initialization sequence, a second starting address—page 17_8 to 34_8—can be used. This starting address is used if the user wishes to retain any program that might exist in memory.

Once started the interpreter responds with READY.

INPUT LINE FORMAT

Each line entered is terminated with the carriage-return key. The line-feed key is ignored. Carriage-return automatically step terminal to next line and waits for next line statement number input. Statements can be entered in any order, but they will be executed in numerical order. All blanks outside of quotation marks are ignored by the interpreter. Up to 72 characters may be entered/line.

INPUT LINE EDITING—A program can be edited by using the line numbers to insert or delete statements. Typing a line number and then typing a carriage return causes the statement at that line number to be deleted. Since the statements can be entered in any order, a statement can be inserted between two existing statements by giving it a line number between the two existing statement line numbers. To replace a statement, the new statement should have the same line number as the old statement.

It is possible to correct errors on a line being entered by either deleting the entire line or by deleting one or more characters on the line. A character is deleted with either the rubout key or the shift/O key. Several characters can be deleted by using the rubout key several times in succession. Character deletion is, in effect, a logical backspace. To delete the line you are currently typing, use the CNTRL/Y key.

BASIC PROGRAM EXECUTION—Entering a RUN command, after a BASIC program has been entered into the microcomputer, will cause the current program to begin execution at the first statement number. RUN always begins at the lowest statement number.

ERROR MESSAGES—If an unrecognizable command is entered, the word WHAT? is printed on the teletype. Simply retype the command. It may also have been caused by a missing line number on a BASIC statement, in which case you should retype the statement with a line number.

During program execution and whenever new lines are added to the program, a test is made to see if there is sufficient memory. If the memory is full, MEMORY FULL is printed on the teletype. At this point, you should enter one of the single digits below to indicate what you wish to do:

Number Entered	Meaning
0	(RUN) runs
0	(RUN) runs the program in memory
1	(PLST) outputs program in memory to paper tape punch
2	(LIST) lists program in memory
3	(SCR) erases program in memory
4	none of the above (will cause WHAT? to be printed out on the teletype).

To help you select the best alternative, a brief description of how the statements are manipulated in memory will be helpful. All lines entered as program are stored in memory. If lines are deleted or replaced, the originals still remain in memory. Thus, it is possible, if a great deal of line editing has been done, to have a significant portion of memory taken up with unused statements. If a MEMORY FULL message is obtained in these circumstances, then the best thing to do is punch a tape of the program (entering number 1), then erase the program memory with a SCR command (or a number 3, if memory is too full to accept commands), and then re-enter your program using the high-speed paper-tape reader with the PTAPE command.

If an error is encountered while executing a program, an error message is typed out that indicates an error number and the line number in which the error occurred. These numbered error messages are as follows:

Error Number	Error Message
1	Program has no END statement
2	Unrecognizable keyword at beginning of statement
3	Source statements exist after END statement
4	Designation line number is improperly formed in a GOTO, GOSUB, or IF statement
5	Designation line number in a GOTO, GOSUB, or IF statement does not exist
6	Unexpected character
7	Unfinished statement
8	Illegally formed expression
9	Error in floating-point conversion
10	Illegal use of a function
11	Duplicate array definition
12	An array is referenced before it is defined
13	Error in the floating-point-to-integer routine, Number is too big
14	Invalid relation in an IF statement

LLL 8080 BASIC INTERPRETER PROGRAMS EXAMPLES

PRINT STATEMENT PROGRAM EXAMPLE—The program below gives a few examples of the use of the print statement.

```
1 PRINT"THE PRE-FORMATTED COLUMNS ARE SHOWN BELOW"
2 PRINT 1,2,3,4,5
4 PRINT
10 PRINT "INPUT 1ST NUMBER"
20 INPUT A
30 PRINT "INPUT 2ND NUMBER"
40 INPUT B
50 PRINT
60 PRINT"A IS";A
70 PRINT"B IS";B
80 PRINT"A IS";A;"B IS";B;"A+B IS";A+B
100 END
```

```
THE PRE-FORMATTED COLUMNS ARE SHOWN BELOW
 1    2    3    4    5

INPUT 1ST NUMBER
 2
INPUT 2ND NUMBER
 3

A IS 2
B IS 3
A IS 2 B IS 3 A+B IS 5
```

PLOT FUNCTION PROGRAM—The following program plots a function on a display. It uses four user-written assembly-language subroutines. The display works as follows: The contents of memory locations on pages 274_8 to 277_8 are displayed as 16 rows of 64 characters each. Thus, if location 201_8 on page 274 contains 301_8 (ASCII A), an A appears in column 2 of Row 3. An example of this program's execution is shown below:

```
RUN
WHAT SHOULD PLOT BE LABELED? MCS80—BASIC INTERPRETER
READY
```

The BASIC and assembly-language programs and the display output are shown below.

BASIC PROGRAM

Display output for Plot Function program.

```
1 REM" THIS ROUTINE WILL PLOT A SET OF AXIS AND QUADRATIC FUNCTION
2 REM" ON A DISPLAY AND THEN LABEL IT.  IT USES A 4 USER WRITTEN
3 REM" SUBROUTINES:
4 REM
5 REM" CALL(1,X,Y,C) - PLACES C IN COLUMN X, ROW Y OF THE DISPLAY
6 REM" WHERE C IS AN ASCII CODED CHARACTER
7 REM
8 REM" CALL(2,A(0)) - READS A CHARACTER STRING FROM THE TTY AND STORES
```

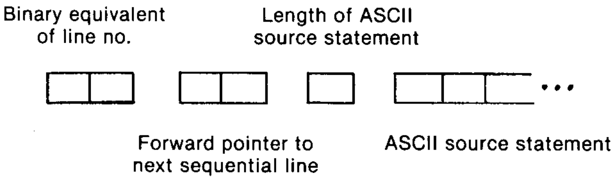
```
9 REM" 1T IN ARRAY A
10 REM
11 REM" CALL(3,A(0)) - WRITES THE CHARACTER STRING STORED IN ARRAY A
12 REM" TO THE DISPLAY
13 REM
14 REM" CALL(4) - CLEARS THE DISPLAY
15 REM
16 REM" START OF PROGRAM
17 REM
18 REM" RESERVE STORAGE AREA FOR TITLE
20 DIMA(10)
30 REM" CLEAR SCREEN
40 CALL(4)
50 REM" ASK FOR AND INPUT TITLE
55 PRINT"WHAT SHOULD PLOT BE LABELED ?";
60 CALL (2,A(0))
70 REM" DRAW AXIS
80 GOSUB 500
90 REM" PLOT FUNCTION
100 LET X= -29
110 GOSUB 1000
120 CALL (1,31+X,8-Y,248)
130 LEXTX = X+1
140 IF X><31 THEN 110
150 REM" OUTPUT TITLE
160 CALL (3,A(0))
165 REM" WE'RE DONE
170 STOP
500 REM" THIS SUB. WILL DRAW A SET OF AXIS
505 LET X=1
510 LET Y=7
520 LETC=173
530 CALL (1,X,Y,C)
540 LETX=X+1
550 IF X><65 THEN 530
560 LET X=31
570 LET Y=1
575 LECTC=252
580 CALL (1,X,Y,C)
590 LETY=Y+1
600 IF Y>< 17 THEN 580
610 RETURN
1000 REM" GIVEN X THIS SUB. CALCULATES (17/900)*X**2-8
1005 REM" FIRST CHECK IF X=0 AS IT WILL UPSET FLOATING POINTPACKAGE
1010 IF X=9 THEN 1045
1015 REM" WE'RE OK - CALCULATE FUNCTION
1020 LET Y=X*X
1025 LET K=17/900
1030 LET Y=Y*K
1035 LET Y=Y-8
1040 RETURN
1045 LETY=-8
1050 RETURN
2000 END
```

```
        .TITLE  'ASSEMBLY LANGUAGE PROGRAM'
        .LOC    166140
        ;       DEFINE EXTERNALS
 FIX    EQU     140120  ;       FIX ROUTINE
 COPDH  EQU     132120  ;       COPY ROUTINE
 FREG1  EQU     165670  ;       FLOATING POINT REGISTER
        DW      SBEND   ;       FWAM
        ;       ENTRIES IN SUB TABLE
        DB      1
        DW      SCOPE

        DB      2
        DW      SUB2
        DB      3
        DW      SUB3
        DB      4
        DW      SUB4
        DB      377Q    ;      NO MORE ENTRYS
        ;       THE CALL TO THIS ROUTINE IS OF THE FORM
        ;               CALL (1 X Y C)
        ;       THE VALUE OF C IS PLACED IN COLUMN X LINE Y
        ;       OF THE DISPLAY

SCOPE:  POP     D       ;      ADDRESS OF CHARACTER
        LXI     H,FREG1 ;      COPY TO FREG1
        CALL    COPDH
        XCHG            ;      ADDRESS TO DE
        CALL    FIX     ;      FIX IT
        INX     D
        INX     D       ;      POINT TO 4TH BYTE
        INX     D
        LDAX    D       ;      GET CHARACTER
        MOV     B,A     ;      SAVE IT IN B
        POP     D       ;      ROW ADD
        LXI     H,FREG1 ;      COPY TO FREG1
        CALL COPDH
        XCHG
        CALL    FIX     ;      FIX IT
        INX     D       ;      GET BYTE 4 TO A
        INX     D
        INX     D
        LDAX    D
        MOV     C,A     ;      SAVE IN C
        POP     D       ;      GET COLUMN ADD
        LXI     H,FREG1 ;      COPY TO FREG1
        CALL    COPDH
        XCHG
        CALL    FIX     ;      FIX IT
        INX     D       ;      POINT TO 4TH BYTE
        INX     D
        INX     D
        LDAX    D       ;      GET IT TO A
        ;       CALCULATION OF ADDRESS
        LXI     H,135777Q

        LXI     D,100Q
LUP:    DCR     C
        JZ      ADINC
        DAD     D
        JMP     LUP
ADINC:  MOV     E,A
        DAD     D       ;      ADD IN COLUMN LOC
        MOV     M,B     ;      STORE CHARACTER
        RET             ;      DONE
        ;       SUB2 READS A TITLE FROM TTY VIA ODT
READ    EQU     333Q    ;      ODT ROUTINE
SUB2:   POP     H       ;      GET STORAGE AREA ADD
        PUSH    H
        MVI     C,0     ;      INIT CNTR

LUP2:   INX     H       ;      BUMP PNTR
        CALL    READ    ;      READ A CHARACTER
        CPI     215Q    ;      CR?
        JZ      DUN2    ;      YES - DONE
        INR     C       ;      INCR CNTR
        MOV     M,A     ;      SAVE CHARACTER
        JMP     LUP2
DUN2:   POP     H
        MOV     M,C     ;      STORE CNT
        MVI     X,212Q  ;      SEND A LF
        RST     6
        RET             ;       DONE
        ;       SUB3 WRITES TITLE TO DISPLAY
SUB3:   POP     H       ;       GET ADD
        LXI     D,137741Q
        MOV     C,M
        INX     H
LUP3:   MOV     A,M     ;       SEND STRING
        STAX    D
        INX     H
        INX     D
        DCR     C
        JNX     LUP3
        RET
        ;       SUB4 CLEARS SCREEN
SUB4:   LXI     H,136000Q
        MVI     A,240Q  ;       SPACE
        MVI     D,0     ;       CNTR S
        MVI     C,4
LUP4:   MOV     M,A     ;       CLEAR IT
        INX     H
        DCR     D
        JNZ     LUP4
        DCR     C
        JNZ     LUP4
        RET
SBEND   EQU     $
        .END
```

DESCRIPTION OF THE INTERPRETER

Following is a brief description of the BASIC interpreter. Hopefully, with this description, it will not be a major project to modify the BASIC to satisfy the reader's specific needs.

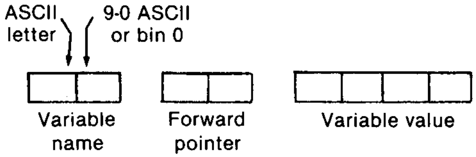
Formats—Source statements are stripped of blanks on input (character strings enclosed in quotes ["] are an exception) and stored as is in memory, using the following format:


Binary equivalent of line no.
Length of ASCII source statement
Forward pointer to next sequential line
ASCII source statement

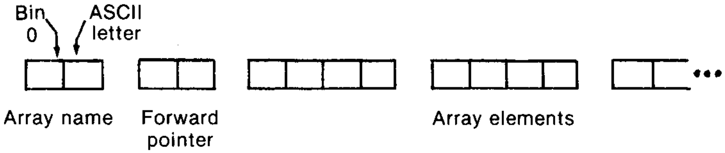
The forward pointer links statements by ascending line numbers. The last line's forward pointer (supposedly an end statement) has value 177777_8 to indicate end of the list.

The symbol table is built up at run time and begins after the most recently entered source statement (the variable STSPAC points to where the symbol table will start). Symbol table entries are shown on the next page.

SCALAR-VARIABLE FORMAT



ARRAY-VARIABLE FORMAT



Subroutines—Following is a list of potentially useful subroutines, with a brief description of each subroutine:

ALPHA	— Value pointed to by H and L is tested to see if it is an ASCII Letter. CY = 1 = >Yes CY = 0 = >No
NUMB	— Same as above but tests for a decimal number (ASCII 0-9).
CHAR2	— Inputs a character from the teletype to a register.
CHK1	— Checks to see if HL are equal to 177777_8 (− 1). CY = 1 = >Yes CY = 0 = >No
CONV (CVRT)	— One of the floating-point routines. Converts floating-point number to a character string. Output is padded to the output buffer.
COPDH	— Copies floating-pont number pointed to by D, E to location pointed to by H, L; uses copy.
COPY	— One of the floating-point routines. Copies floating-point value pointed to by A, L to location pointed to by H, C.
CUB	— Converts the integer-character string pointed to by H, L to its binary equivalent. Vale returns in D, E registers.

DCOMP — Double-byte comparison routine. Compares value in CB to the value in ED.
Z =1 => CB=ED
CY=1 => CB>ED
CY=0 => CB≤ED

DFXL — One of the floating-point routines. Used to float an unsigned integer H, L point to first of four bytes; integer is right justified in first three bytes.

EVAL — Evaluates an expression the first element of which is pointed to by H, L and the length of which is in C. Used to evaluate expressions wherever they are legal in BASIC. C usually contains the length of the source statement line containing the expression.

FINPT — One of the floating-point routines. Converts character string to floating-point number. The variable HLINP contains a pointer to the character string, and the variable CREG contains the length of line containing character string. Mode =0=> data comes from teletype (i.e., only delimiters are g's). Mode=1=> data comes from source statements.

FIX — Fixes a floating-point number. DE points to number to be fixed. Error code 13 is given if number is too big to fix.

FSYM — Finds symbols in symbol table. BC contains symbol. Returns with HL pointing to symbol value.
CY=1=> symbol was found.
CY=0 and a scalar => symbol not found, but inserted and initialized to 0.
CY=0 and an array => not found, no action taken: HL are meaningless.

LADD — Floating-point add routine.

LSUB — Floating-point subtract routine.

LOIU — Floating-point divide routine.

LMUL — Floating-point multiply routine.

LMCM	— One of the floating-point routines. Compares two floating-point values, HL Point to first floating-point values and HB point to second floating-point value. z = 1 = >Equality Cy = 1 = >first<second (Note: compares absolute only, does not reference mantissa sign.)
MCHK	— Waits for flag from port 3. Proper mask is sent in register B.
MEMFUL	— Checks to see if memory is full. HL point to location of memory to be checked. Memory is considered full if it is within 50_{10} locations of the current value of stack pointer.
MULT	— Multiplies two two-byte binary numbers. HL point to last byte of four bytes. First two contain first number. Last two contain second number. Answer returns to BCDE.
NSRCH	— Routine to locate source line in memory passed binary value of line number in DE. Returns address of line in HL, CY = 1 = > not found.
OUTR	— Used by CONV (CURT) to pad output to output buffer.
PAD	— Pads characters to output buffer. A contains character; B contains number of pads.
SYMSRT	— Checks a character string to see if it is a BASIC symbol. HL contains address pointing to 1st character of symbol, C contains length of line that contains symbol. A contains type of symbol sought. 0 = command 1 = keyword z = operator or delimiter 3 = function Returns with 377_8 in a register if nothing found. Otherwise A contains symbol number in appropriate KDAT table. Thus, for symbol type 2, if a 4 is returned, the symbol found was the fourth one (starting with 0) in table KDAT3 (KDAT concatenated with 2 and 1 or A). CIS is updated, but HL is not.

TTYIW — Inputs a line from teletype. Stores starting address at location pointed to by HL. Line edits. Returns length of line in A register (maximum line length is 72 characters).

VALUE — Called with HL pointing to A variable, constant, or function; C contains line length, returns with DE pointing to floating-point value. HL, C are updated.

VAR — Called with HL pointing to character string, C has line length. Determines if character string is a variable. If so, returns with CY = 1, DE pointing to value (subscripts of arrays are evaluated, etc.). HL, C updated. If not, a variable returns CY = 0, HL, C untouched.

WRIT — Dumps contents of output buffer to teletype. Uses entry WRIT1 with D register equal to one to suppress CR/LF.

ZROL — Part of floating-point subroutines. Writes a floating-point zero, starting at location pointed to by HL.

The preceding list contains those subroutines most likely to be used by someone modifying BASIC. If you plan on using one of the routines, you should examine it and its comments carefully.

Variables—Following is a list of interpreter variables, with a description of each variable:

MEMST — Assembly time variable. Contains the first available RAM Location. This is where active variables start.

MEMEND — Asembly time variable. Contains the last available location in RAM.

SEND — Has value 6, used with RST instruction to print characters via ODT.

OBUFF — Output buffer, the first location contains the number of characters in the buffer +1.

IBUF — Input buffer, occupies same area as OBUFF.

STLINE — Points to first source line to be executed. If no source, contains 177777_8.

NLINE, NL2, NL4, NL6	— Contain address, binary-equivalent line number, forward pointer, and length of next input line.
KLINE, KL2, KL4, KL6	— Same as above, but used by a subroutine that inserts lines in sequential order (insert).
PLINE, PL2, PL4, PL6	— Subroutine insert to order statements sequentially.
KASE, LEN	— Temporary storage for command mode routines.
MULT1, MULT2	— Used to store binary values to be multiplied.
SBSAV	— Temporary storage for call-statement processor.
STSPAC	— Next available location in memory, symbol table starts here at run time.
LPNT	— Pointer to the current line at run time.
CPNT	— Pointer to current character in current line at run time.
KFPNT	— Point to next sequential line at run time.
FREG1, FREG2	— Two floating-point registers.
HLINP, CREG	— Temporary storage for HL and C registers for routine INP
NXTSP	— Pointer to next available space of memory for symbol table.
GREG	— General register, in and out instructions are stored here and executed for get and put functions.
MODE	— Indicates to INP routine whether input data comes from source or teletype.
MESCR	— Temporary storage for call-statement processor. Points to next available space after symbol table. Area after the symbol table is used to store intermediate results of expressions or constants passed to user subroutines.
VARAD	— Temporary storage space for input-statement processor.

VEND — Assembly time variable. Indicates end of interpreter variable-storage area and where FWAM pointer is to go.

FWAM — First word of available memory pointer. This is where user source programs go.

Some of the above variables occupy the same area of memory. This is because some variables are used only in the command mode and others only at runtime. To conserve space, they share the same memory locations.

New BASIC Statements—To add additional statements to the BASIC, use the following procedure. First, insert the statement keyword in the data tables for subroutine SYMSRT. Then, insert the starting address of the statement processor in the interpreter JUMP table. Finally, the statement processor itself must be inserted.

The keyword must be entered in the table KDAT2. The first byte must be the keyword length and the next bytes hold the ASCII-coded keyword. The table must end with A 377_8. If the keyword is the Nth entry in the table, on return from SYMSRT, the A register will hold N-1 if the keyword is found.

The starting address of the statement processor must be inserted into table JTBL. The order of keywords in KDAT2 must correspond with statement processor addresses in JTBL since, on return from SYMSRT, the A register times two is used as offset in JTBL to determine processor address.

The statement processor must be placed somewhere in memory. Generally, the first thing done in the statement processors is to load the pointer to the statement (LHLD CPNT) and increment past the keyword (since HL is not updated by SYMSRT). On entry, C contains the number of characters in the line minus those checked by SYMSRT. The end of the processor should be a "JMPIED" instruction.

New Functions—New functions must be added to SYSSRT Data Table KDAT4 in the same manner as for key words. The function itself must be placed in subroutine "VALUE." Presently, the only function in VALUE is GET.

Message Lines—The following description tells how to incorporate messages into BASIC output routines. Currently, to output a message to the teletype, the user executes an LXI H,ODATA, then a call to FORMK where K is an integer indicating which message is wanted (i.e., K = z indicates "TURN ON PUNCH") FORM pads the message into the output buffer. Then A "CALL WRIT" writes the contents of the buffer.

Suppose the message "POTATO BASIC" is to be added. Preceding the form 9 instruction, we will insert "FOR10: INR L." At the end of the ODATA table, we add "DB ODAT8 and 377Q." And, after message ODAT 7, we add ODAT8 DB * 12, "POTATO BASIC." Now, the following program segment:

```
        LXI         H,ODATA
        CALL        FOR10
        CALL        WRIT,
```

will cause "POTATO BASIC" to be output to the teletype.

ODT-80 is an octal debugging routine for use on the Intel 8080 microprocessor. This routine provides the capability to examine and modify all of the memory that is available to the micro-computer and transfer program control to the created program. ODT-80 makes use of simple keyboard commands from any terminal—such as a teletypewriter—that is attached to the system.

ODT-80 (Octal Debugging Technique) is a program written for the MCS-80 that allows the user to modify a program via a teletypewriter keyboard. The program occupies 400 octal words and must be located in the lowest memory page of the MCS-80 system, since the program uses the RESTART instructions.

ODT has been proved to be an effective aid to debugging on microprocessors. The first version,[1] for the Intel 8080,* has been "front panel" for virtually hundreds of microprocessor applications. The author submits this ODT for the 8080 in hopes that the tradition of soft panels may be perpetuated.

SYSTEM REQUIREMENTS

All addresses of memory locations and contents of memory locations are referred to in octal numbers. A question mark (?) will be typed for any illegal input.

The minimum system requirements for using ODT are as follows:

- MCS—80 computer set
- ODT programmable read only memory (PROM) at memory page 000_8
- 256 word (RAM) at page 010_8
- Teletype interface with the following codes:
  OUT 2—SEND ASCII character
  IN 2—Input word from TTY

```
                 D7        D0
IN 3—Read Flags  11 111 111 (flag word)
Sending Done  _____________↑↑
Word Received_______________|
```

UTILITY ROUTINES

The following subroutines are available to the user as utility routines for other programs:

Address	Call	Routine
307	RST ODT	Restart ODT Program. This is useful for error branching in program debugging.
367	RST SEND	Send the ASCII character presently in the "A" register.

315 333 0	CAL READ	Wait for a character to be received from the teletype and return with the ASCII character in the "A" register. The "A" and "B" registers are used in this routine.
315 370 0	CALL CRLF	Send a carriage return and a line feed to the teletypewriter. The "A" register is used in this routine.
315 301 0	CAL OCTALP	Send a space and type in Octal the three digit number in the "A" register. The A, B, and E registers are used in this routine.

COMMANDS

n_8/) —The ASCII Slash (/) character is used to Open the n_8 address and type the contents in octal.

(LF) —The ASCII Line Feed (LF) character is used to close the currently open address, and open the next sequential address. The contents of the open register may be changed by typing the octal number to be input and then typing a (CR).

(.) —The ASCII Period (.) operator character may be used before the (/) operator to open the address last used.

(n_8S) —The SET command is used to set the H register to the memory page to be accessed.
(EX) 10S ;H = 010_8

(n_8R) —The READ operator is used to start a loader program in memory page No. 2, location 0.

If this command is preceded by an "nS" command, the n value will be passed to the loader program in the H register.

(n_8G) —The GO routine is used to start a program in memory. The octal number typed before the "G" operator will set the starting address in memory. The "G" operator should be preceded by an "nS" command to select the desired page.

(CTRL-C)	—The ASCII Control C character is used to command the type out of the top two locations in the stack. (See trap.) Leaves the stack pointer at its initial position -2.
(CR)	—The ASCII Carriage Return (CR) character is used to close the currently open address.

TRAP

The trap feature of ODT works as follows: When the central processor encounters a 377_8 as an instruction, the processor decodes this as a restart to location 70_8 in memory 0_8. An example of this is when a nonexistent memory is addressed, or when a 377_8 is placed in a program for a break point. At this time, ODT stores in the pushdown stack the address of the errant location and all of the registers. The trap indication is a "T" typed out on the teletypewriter. Control is now back in ODT and multiple Control-C's (CTRL-C) typed by the operator will yield, in sets of two (One set for each CTRL-C Typed), the trapped information in the following format:

ERROR	ADDRESS +1	REGISTERS							
PAGE NO.	LOCATION	A	F	B	C	D	E	H	L
XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX

The "F" register is the status flags of the 8080, with the format shown in Fig. 1.

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
MSB (SIGN)	ZERO FLAG	0	CARRY 1	0	EVEN PARITY	1	CARRY 2

Figure 1. "F" register format.

A CRTL-C typed at any time will type out the pushdown stack but *not* in the format shown above! The above format is only available immediately after a "T" has been sent by ODT.

If a continuous string of "T" are sent to the TTY without stopping, this is an indication that the stack pointer is pointing at nonexistent memory. It will be necessary to restart ODT.

RESTART/INTERRUPT LOCATIONS

There are five segments of memory reserved in ODT for INTERRUPT or RESTART operation. These locations, shown in Fig. 2, contain jumps to the scratch RAM memory #10, used by ODT. This allows interrupt service to be handled even though memory #0 is preprogrammed to contain ODT.

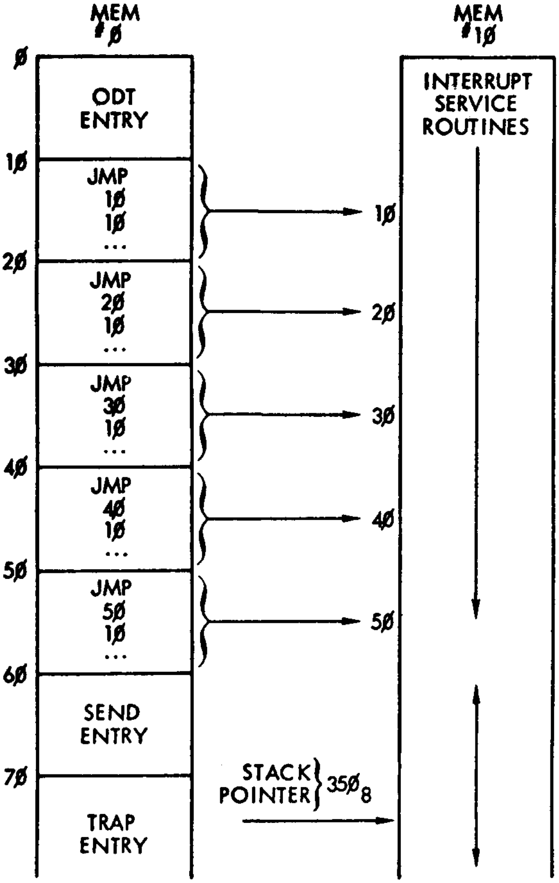


Figure 2. RESTART/INTERRUPT locations.

STACK POINTER

The stack pointer is reset to location 350_8 every time ODT is restarted via location 0 of ROM 0—in other words, whenever a "?" is sent by ODT. ODT and other programs use the stack pointer; therefore, memory locations plus and minus this location are apt to be overwritten. However, the stack pointer moves down in memory (high addresses to low addresses), so normal operation will keep the stack pointer in RAM 10_8.

EXAMPLE OF TYPICAL DEBUGGING OPERATION

The following example illustrates a typical debugging operation. It is assumed that a program has been assembled and that the program is to be loaded by a loader in PROM 2.

1. Set the memory field with the S command, and read the tape with the R command.

```
10S*            ;SET MEMORY FIELD TO 10
0R              ;START READER ON TTY
?               ;WHEN TAPE IS READ IN ODT
                RESTARTS (startup of ODT
                depends upon the reader pro-
                gram in PROM 2)
```

2. Start the program with the G command.

```
10S             ;START PROGRAM AT LOCA-
                TION 0
0G
TEST PROGRAM ;TYPED BY PROGRAM WITH AN ERROR
```

3. Change location (30) to correct output. Restart ODT.

```
?
10S
30/327 322)     ;CHANGE "W" TO AN "R"

      TEST PROGRAM ;CORRECTED OUTPUT
```

EXAMPLE PROGRAM LISTING

```
                                 ;ODT TEST PROGRAM
                                 ;10-21-74
000006                 SEND EQU  6
000370                 CRLF EQU  370Q
                                 ;
                                 ;PROGRAM PROPER
                                 ;
004000                           ORG 4000Q
004000   041 022 010             LXI H TABLE          ;SET UP ADDRESS
004003   176           LOOP:     MOV A,M              ;GET ENTRY
004004   376 000                 CPI 0
004006   312 016 010             JZ ND                ;IF 0 END OF LIST
004011   367                     RST SEND             ;TYPE CHARACTER
004012   043                     INX H
004013   303 003 010             JMP LOOP             ;LOOP


004016   315 370 000 ND:         CALL CRLF            ;SEND CRLF

004021   166                     HLT
                                 ;
004022   324           TABLE:    DB 324Q                 ;T
004023   305                     DB 305Q                 ;E
004024   323                     DB 323Q                 ;S
004025   324                     DB 324Q                 ;T
004026   340                     DB 240Q                 ;SPACE
```

```
004027   240          DB 320Q          ;P
004030   327          DB 327Q          ;W FOR ERROR
004031   317          DB 317Q          ;O
004032   307          DB 307Q          ;G
004033   322          DB 322Q          ;R
004034   301          DB 301Q          ;A
004035   315          DB 315Q          ;M
004036     0          DB 0
                      END

NO PROGRAM ERRORS


                 SYMBOL TABLE

 * 01

 A      000007   B      000000   C      000001   CRLF   000370
 D      000002   E      000003   H      000004   L      000005
 LOOP   004003   M      000006   ND     004015   PSW    000006
 SEND   000006   SP     000006   TABLE  004021
```

ODT-80 PROGRAM LISTING

```
SAMPLE JUMP TABLE *

SEND     EQU    344Q
READ     EQU    333Q
MCHK     EQU    113144Q

         ORG    400Q

SPNT:    DW     37777Q
SUBAD:   DW     SUBS
CONIN:   JMP    READ
CONOUT:  JMP    SEND
STATUS:  JMP    STAT
HSRDR:   JMP    HSR

         ORG    500Q

STAT:    IN     3             ; READ STATUS PORT
         RET

HSR:     MVI    B,4
         OUT    5
         CALL   MCHK
         IN     5
         RET

SUBS:    DB     377Q

         END
```

BASIC MASK-ROM DOCUMENTATION

```
THE 6K 'MASK-ROM' VERSION OF THE 'LLL INTERPRETIVE
BASIC' OCCUPIES PAGES 200 THRU 227 (OCTAL).

ALL I/O IS DONE THRU A JUMP-TABLE LOCATED ON PAGE 1.
THIS JUMP-TABLE MUST BE LOCATED AT THE BELOW
SPECIFIED LOCATIONS (GIVEN IN OCTAL):


PAGE 1   LOC.  0     DW   ADDR.      ; ADDR. IS THE LOCATION
                                     ; OF THE STACK-POINTER

         LOC.  2     DW   ADDR.      ; ADDR. IS THE LOCATION OF
                                     ; THE USER-SUB TABLE
                                     ; (SEE UCID-17090 PAGE 9)

         LOC.  4     JMP  CONIN      ; CONIN IS LOCATION OF CONSOLE
                                     ; INPUT ROUTINE (BASIC EXPECTS
                                     ; CHAR. TO BE RETURNED IN THE
                                     ; B-REGISTER)

         LOC.  7     JMP  CONOUT     ; CONOUT IS LOCATION OF CONSOLE
                                     ; OUTPUT ROUTINE (BASIC PASSES
                                     ; CHAR. IN A-REGISTER)

         LOC. 12     JMP  STATUS     ; STATUS READS THE I/O STATUS
                                     ; PORT AND RETURNS THE FOLLOWING
                                     ; IN THE A-REGISTER TO BASIC -
                                     ;
                                     ; B7 B6 B5 B4 B3 B2 B1 B0
                                     ;
                                     ; B0=1   IF CHAR. AVAILABLE
                                     ;        FOR CONSOLE INPUT.
                                     ; B1=1   IF DATA TRANSMISSION
                                     ;        COMPLETE.
```

```
                 LOC. 15      JMP   HSRDR      ; HSRDR IS LOCATION OF HIGH-
                                               ; SPEED PAPER-TAPE READER
                                               ; ROUTINE
                                               ; (BASIC EXPECTS CHAR. TO BE
                                               ;  RETURNED IN A-REGISTER)
```

BASIC INTERPRETER

```
0400                    MEMST     EQU    2000Q              ;MUST BE ON PAGE BOUNDARY
                        ; DEFINE I-O/SP/SUB ADD. JUMP TABLE LOCATIONS
0100                    SPNT      EQU    400Q
0102                    SUBAD     EQU    402Q
0104                    CONIN     EQU    404Q
0107                    CONOUT    EQU    407Q
010A                    STATUS    EQU    412Q
010D                    HSRDR     EQU    415Q
                        ;
0400                    OBUFF     EQU    MEMST              ;INPUT AND OUTPUT BUFFERS OCCUPY
0401                    IBUF      EQU    MEMST+1            ;SAME AREA
0449                    STLINE    EQU    MEMST+111Q
044B                    NLINE     EQU    MEMST+113Q
044D                    NL2       EQU    MEMST+115Q
044F                    NL4       EQU    MEMST+117Q
0451                    NL6       EQU    MEMST+121Q
0452                    KLINE     EQU    MEMST+122Q
0454                    KL2       EQU    MEMST+124Q
0456                    KL4       EQU    MEMST+126Q
0458                    KL6       EQU    MEMST+130Q
0459                    PLINE     EQU    MEMST+131Q
045B                    PL2       EQU    MEMST+133Q
045D                    PL4       EQU    MEMST+135Q
045D                    SBSAV     EQU    PL4                ;RETURN ADD. SAVE FOR CALL STMT.
045F                    PL6       EQU    MEMST+137Q
0460                    KASE      EQU    MEMST+140Q
0461                    LEN       EQU    MEMST+141Q
0462                    MULT1     EQU    MEMST+142Q
0464                    MULT2     EQU    MEMST+144Q
0459                    NXTSP     EQU    MEMST+131Q
044B                    STSPAC    EQU    MEMST+113Q
```

```
97C7                NORM    EQU   113707Q
97CA                FLOAT   EQU   113712Q
97CD                ZROL    EQU   113715Q
0452                LPNT    EQU   MEMST+122Q
0458                KLEN    EQU   MEMST+130Q
045B                CPNT    EQU   MEMST+133Q
0456                KFPNT   EQU   MEMST+126Q
0480                FREG2   EQU   MEMST+200Q
0484                CREG    EQU   MEMST+204Q
97D0                LADD    EQU   113720Q
97D3                LMUL    EQU   113723Q
97D6                LDIV    EQU   113726Q
97D9                LSUB    EQU   113731Q
97DC                DFXL    EQU   113734Q
97DF                LMCM    EQU   113737Q
0486                HLINP   EQU   MEMST+206Q
0477                GREG    EQU   MEMST+167Q
047C                FREG1   EQU   MEMST+174Q
0466                SCR     EQU   MEMST+146Q
97E5                CONV    EQU   113745Q
0485                MODE    EQU   MEMST+205Q
97E8                FINPT   EQU   113750Q
97EB                MULT    EQU   113753Q
97EE                PTVAL   EQU   113756Q
97F1                DCOMP   EQU   113761Q
97F4                MCHK    EQU   113764Q
97F7                CHAR2   EQU   113767Q
0488                MESCR   EQU   MEMST+210Q     ;DEFINE MEMORY SCR AREA PNTR
048A                VARAD   EQU   MEMST+212Q     ;TEMP SPACE FOR INP. STMT.
048C                VNAME   EQU   MEMST+214Q     ;TEMP SPACE FOR 'FOR-NEXT'
048E                VLOC    EQU   MEMST+216Q     ;TEMP SPACE FOR 'FOR-NEXT'
0490                FLIMT   EQU   MEMST+220Q     ;TEMP SPACE FOR 'FOR-NEXT'
0494                NEST    EQU   MEMST+224Q     ;NESTING STACK-POINTER
0496                STAC    EQU   MEMST+226Q     ;FOR-NEXT NESTING STACK
0014                STSIZ   SET   20             ;STACK SIZE. ALLOWS 10 NESTED
0496                TOPNS   EQU   STAC           ;FOR-NEXT TOP OF STACK
04AA                BOTNS   EQU   STAC+STSIZ     ;BOTTOM OF STACK
04AA                VEND    EQU   MEMST+252Q     ;DEF. END OF VAR. STORAGE AREA
                    ;  MAIN ROUTINE--HANDLES ALL USER INPUT
8000                        ORG   100000Q
8000    21 00 04    M1:     LXI   H,OBUFF
```

```
8003      36 01                     MVI    M,1
8005      21 49 04                  LXI    H,STLINE
8008      36 FF                     MVI    M,377Q
800A      2C                        INR    L
800B      36 FF                     MVI    M,377Q
800D      2A DA 8F                  LHLD   FWAM            ;GET ADDRES ØF FWA MEM.
8010      22 4B 04                  SHLD   NLINE           ;STØRE IN FREE SPACE PNTR.
8013      2A 00 01        M1A:      LHLD   SPNT
8016      F9                        SPHL
8017      21 69 84        M2:       LXI    H,ØDATA
801A      CD 57 84                  CALL   FØRM1
801D      CD D3 82                  CALL   WRIT
8020      2A 4B 04        M3:       LHLD   NLINE
8023      23                        INX    H
8024      23                        INX    H
8025      23                        INX    H
8026      23                        INX    H
8027      23                        INX    H
8028      CD D2 83                  CALL   TTYIN
802B      4F                        MØV    C,A
802C      FE 00                     CPI    0
802E      CA 20 80                  JZ     M3
8031      CD 25 82                  CALL   ALPHA
8034      DA 43 80                  JC     M4
8037      CD 17 82                  CALL   NUMB
803A      D4 9F 81                  CNC    WHAT
803D      CD 90 80                  CALL   INSERT
8040      C3 20 80                  JMP    M3
8043      3E 00           M4:       MVI    A,0
8045      CD 00 83                  CALL   SYMSRT
8048      3C              M4A:      INR    A
8049      CC 9F 81                  CZ     WHAT
804C      3D                        DCR    A
804D      CA 85 86                  JZ     RUN
8050      3D                        DCR    A
8051      CC AB 81                  CZ     TAPE
8054      CA 17 80                  JZ     M2
8057      3D                        DCR    A
8058      CC D2 81                  CZ     LIST
805B      CA 17 80                  JZ     M2
805E      3D                        DCR    A
```

```
805F      CA 00 80                    JZ      M1
8062      3D                          DCR     A
8063      C4 9F 81                    CNZ     WHAT
                         ; ROUTINE TO INPUT FROM HSR
8066      CD 17 85       PTAPE:       CALL    CHAR5
8069      FE 00                       CPI     0
806B      CA 66 80                    JZ      PTAPE
806E      CD E4 84       PT1:         CALL    HSRIN
8071      4F                          MOV     C,A .
8072      FE 00                       CPI     0
8074      CA 66 80                    JZ      PTAPE
8077      CD 25 82                    CALL    ALPHA
807A      DA 43 80                    JC      M4
807D      CD 90 80                    CALL    INSERT
8080      CD 17 85                    CALL    CHAR5
8083      FE 00                       CPI     0
8085      CA 17 80                    JZ      M2
8088      23                          INX     H
8089      23                          INX     H
808A      23                          INX     H
808B      23                          INX     H
808C      23                          INX     H
808D      C3 6E 80                    JMP     PT1
                         ; ROUTINE TO HANDLE ALL SOURCE LINE INPUT.
                         ; THIS INCLUDES INSERTION, DELEATION, AND
                         ; ADDITION OF NEW SOURCE LINES.
8090      2B             INSERT:      DCX     H
8091      71                          MOV     M,C
8092      23                          INX     H
8093      CD 2D 82                    CALL    CVB
8096      FE 05                       CPI     5
8098      DA A3 80                    JC      ISR1A
809B      C4 9F 81                    CNZ     WHAT
809E      7B                          MOV     A,E
809F      17                          RAL
80A0      DC 9F 81                    CC      WHAT
80A3      2A 4B 04       ISR1A:      LHLD     NLINE
80A6      72                          MOV     M,D
80A7      23                          INX     H
80A8      73                          MOV     M,E
80A9      21 4B 04                    LXI     H,NLINE
```

```
80AC    CD EE 97            CALL    PTVAL
80AF    2A 49 04            LHLD    STLINE
80B2    CD A6 82            CALL    CHK1
80B5    D2 D5 80            JNC     ISRT3
80B8    2A 4B 04            LHLD    NLINE
80BB    22 49 04            SHLD    STLINE
80BE    16 FF       ISRT1:  MVI     D,377Q
80C0    5A                  MOV     E,D
80C1    CD 8C 81            CALL    STPNT
80C4    23                  INX     H
80C5    7E          ISRT2:  MOV     A,M
80C6    C6 05               ADI     5
80C8    2A 4B 04            LHLD    NLINE
80CB    85                  ADD     L
80CC    6F                  MOV     L,A
80CD    3E 00               MVI     A,0
80CF    8C                  ADC     H
80D0    67                  MOV     H,A
80D1    22 4B 04            SHLD    NLINE
80D4    C9                  RET
80D5    22 52 04    ISRT3:  SHLD    KLINE
80D8    21 52 04    ISRT4:  LXI     H,KLINE
80DB    CD EE 97            CALL    PTVAL
80DE    21 4D 04            LXI     H,NL2
80E1    56                  MOV     D,M
80E2    2C                  INR     L
80E3    5E                  MOV     E,M
80E4    21 54 04            LXI     H,KL2
80E7    46                  MOV     B,M
80E8    2C                  INR     L
80E9    4E                  MOV     C,M
80EA    CD F1 97            CALL    DCOMP
80ED    CA 22 81            JZ      ISRT6
80F0    DA 7B 81            JC      ISR12
80F3    2A 56 04            LHLD    KL4
80F6    CD A6 82            CALL    CHK1
80F9    DA 10 81            JC      ISRT5
80FC    E5                  PUSH    H
80FD    2A 52 04            LHLD    KLINE
8100    22 59 04            SHLD    PLINE
8103    21 59 04            LXI     H,PLINE
```

```
8106    CD EE 97                CALL   PTVAL
8109    E1                      PØP    H
810A    22 52 04                SHLD   KLINE
810D    C3 D8 80                JMP    ISRT4
8110    2A 4B 04       ISRT5:   LHLD   NLINE
8113    CD 92 81                CALL   NØLINE
8116    C8                      RZ
8117    EB                      XCHG
8118    2A 52 04                LHLD   KLINE
811B    CD 8C 81                CALL   STPNT
811E    EB                      XCHG
811F    C3 BE 80                JMP    ISRT1
8122    2A 4B 04       ISRT6:   LHLD   NLINE
8125    CD 92 81                CALL   NØLINE
8128    C2 49 81                JNZ    ISRT8
812B    2A 49 04                LHLD   STLINE
812E    EB                      XCHG
812F    2A 52 04                LHLD   KLINE
8132    E5                      PUSH   H
8133    C1                      PØP    B
8134    CD F1 97                CALL   DCØMP
8137    2A 56 04                LHLD   KL4
813A    CA 45 81                JZ     ISRT7
813D    EB                      XCHG
813E    2A 59 04                LHLD   PLINE
8141    CD 8C 81                CALL   STPNT
8144    C9                      RET
8145    22 49 04       ISRT7:   SHLD   STLINE
8148    C9                      RET
8149    2A 56 04       ISRT8:   LHLD   KL4
814C    EB                      XCHG
814D    2A 4B 04                LHLD   NLINE
8150    CD 8C 81                CALL   STPNT
8153    2A 52 04       ISRT9:   LHLD   KLINE
8156    EB                      XCHG
8157    2A 49 04                LHLD   STLINE
815A    E5                      PUSH   H
815B    C1                      PØP    B
815C    CD F1 97                CALL   DCØMP
815F    CA 72 81                JZ     ISR11
8162    2A 4B 04                LHLD   NLINE
```

```
8165     EB                             XCHG
8166     2A 59 04                       LHLD    PLINE
8169     CD 8C 81                       CALL    STPNT
816C     21 51 04           ISR10:     LXI     H,NL6
816F     C3 C5 80                       JMP      ISRT2
8172     2A 4B 04           ISR11:     LHLD    NLINE
8175     22 49 04                       SHLD    STLINE
8178     C3 6C 81                       JMP      ISR10
817B     2A 52 04           ISR12:     LHLD    KLINE
817E     EB                             XCHG
817F     2A 4B 04                       LHLD    NLINE
8182     CD 92 81                       CALL    NOLINE
8185     C8                             RZ
8186     CD 8C 81                       CALL    STPNT
8189     C3 53 81                       JMP      ISRT9
                            ; ROUTINE TO STORE POINTERS INTO MEM ARRAY
818C     23                 STPNT:      INX     H
818D     23                             INX     H
818E     73                             MOV     M,E
818F     23                             INX     H
8190     72                             MOV     M,D
8191     C9                             RET
                            ; ROUTINE TO CHECK NEW LINE FOR SOURCE STMT.
8192     E5                 NOLINE:     PUSH    H
8193     23                             INX     H
8194     23                             INX     H
8195     23                             INX     H
8196     23                             INX     H
8197     4E                             MOV     C,M
8198     23                             INX     H
8199     CD 74 82                       CALL    LENGTH
819C     E1                             POP     H
819D     B9                             CMP     C
819E     C9                             RET
                            ; ROUTINE TO RESPOND WITH 'WHAT?' FOR UNIDENTIFIED
                            ; COMMAND.
819F     21 69 84           WHAT:       LXI     H,ODATA
81A2     CD 53 84                       CALL    FORM7
81A5     CD D3 82                       CALL    WRIT
81A8     C3 13 80                       JMP     M1A
                            ; ROUTINE TO PUNCH PAPER TAPE OF SOURCE.
```

```
81AB      F5                 TAPE:     PUSH    PSW
81AC      C5                           PUSH    B
81AD      21 69 84                     LXI     H,ODATA
81B0      CD 56 84                     CALL    FORM2
81B3      CD D3 82                     CALL    WRIT
81B6      3E 00                        MVI     A,0
81B8      C1                           POP     B
81B9      06 40                        MVI     B,100Q
81BB      F5                           PUSH    PSW
81BC      C5                           PUSH    B
81BD      CD B0 82                     CALL    PAD
81C0      CD D3 82                     CALL    WRIT
81C3      C1                           POP     B
81C4      C5                           PUSH    B
81C5      CD D2 81                     CALL    LIST
81C8      C1                           POP     B
81C9      F1                           POP     PSW
81CA      CD B0 82                     CALL    PAD
81CD      CD D3 82                     CALL    WRIT
81D0      F1                           POP     PSW
81D1      C9                           RET
                             ; ROUTINE TO LIST TO TTY THE SOURCE STMTS.
81D2      2A 49 04           LIST:     LHLD    STLINE
81D5      CD A6 82                     CALL    CHK1
81D8      DA 13 80                     JC      M1A
81DB      22 59 04                     SHLD    PLINE
81DE      21 FF FF                     LXI     H,177777Q
81E1      22 52 04                     SHLD    KLINE
81E4      0D                           DCR     C
81E5      C4 57 85                     CNZ     BOUND
81E8      2A 59 04                     LHLD    PLINE
81EB      23                 LIS1:     INX     H
81EC      23                           INX     H
81ED      46                           MOV     B,M
81EE      23                           INX     H
81EF      4E                           MOV     C,M
81F0      C5                           PUSH    B
81F1      23                           INX     H
81F2      CD 58 84                     CALL    FORM5
81F5      CD D3 82                     CALL    WRIT
81F8      C1                           POP     B
```

```
81F9      2A 52 04                 LHLD    KLINE
81FC      EB                       XCHG
81FD      CD F1 97                 CALL    DCOMP
8200      C8                       RZ
8201      68                       MOV     L,B
8202      61                       MOV     H,C
8203      CD 09 82                 CALL    QUITT              ;CHECK FOR INTERRUPTION
8206      C3 EB 81                 JMP     LIS1               ;NONE - CONTINUE
                         ;THIS ROUTINE CHECKS PORT 2 FOR A CNTRL/S CHARACTER
                         ;IF ONE IS FOUND THEN EXECUTION IS TO BE INTERRUPTED
                         ;CONTROL IS PASSED TO M1A
8209      CD 0A 01       QUITT:    CALL    STATUS              ;TEST FLAG PORT
820C      1F                       RAR                        ;FLAG TO CY
820D      D0                       RNC                        ;NOTHING THERE
820E      CD 04 01                 CALL    CONIN              ;FLAG WAS SET, GET DATA
8211      FE 93          QTCHK:    CPI     223Q               ;WAS IT CNTRL/S?
8213      CA 13 80                 JZ      M1A                ;YES
8216      C9                       RET                        ;NO, RETURN
                         ;  ROUTINES NUMB AND ALPHA CHECK IF CONTENTS OF MEMORY
                         ;  LOCATION IN HL CONTAIN ASCII NUMERIC OR ALPHBETIC
                         ; CHARACTER. RETURN CY=1 IF YES, CY=0 IF NO.
8217      C5             NUMB:     PUSH    B
8218      06 B0                    MVI     B,260Q
821A      0E BA                    MVI     C,272Q
821C      7E             C1:       MOV     A,M
821D      B8                       CMP     B
821E      3F                       CMC
821F      D2 23 82                 JNC     BAC
8222      B9                       CMP     C
8223      C1             BAC:      POP     B
8224      C9                       RET
8225      C5             ALPHA:    PUSH    B
8226      06 C1                    MVI     B,301Q
8228      0E DB                    MVI     C,333Q
822A      C3 1C 82                 JMP     C1
                         ; ROUTINE TO CONVERT ASCII NUMERIC CHAR. STRING TO
                         ; EQUIVALENT BINARY NUMBER. RETURNS EQUIVALENT IN
                         ; DE REG.  LENGTH OF LINE PASSED IN REG C AND
                         ; RETURNED POINTING TO LAST NUMERIC CHAR. LENGTH
                         ; OF CHAR STRING RETURNED IN REG A.
822D      E5             CVB:      PUSH    H
```

```
822E      C5                    PUSH    B
822F      CD 74 82              CALL    LENGTH
8232      F5                    PUSH    PSW
8233      E5                    PUSH    H
8234      FE 00                 CPI     0
8236      CA 6B 82              JZ      CVB2
8239      21 60 04              LXI     H,KASE
823C      77                    MOV     M,A
823D      2C                    INR     L
823E      71                    MOV     M,C
823F      21 0A 00              LXI     H,10
8242      22 62 04              SHLD    MULT1
8245      21 00 00              LXI     H,0
8248      22 64 04              SHLD    MULT2
824B      21 65 04              LXI     H,MULT2+1
824E      CD EB 97    CVB1:     CALL    MULT
8251      E3                    XTHL
8252      7E                    MOV     A,M
8253      DE B0                 SBI     260Q
8255      82                    ADD     D
8256      57                    MOV     D,A
8257      3E 00                 MVI     A,0
8259      8B                    ADC     E
825A      5F                    MOV     E,A
825B      23                    INX     H
825C      E3                    XTHL
825D      72                    MOV     M,D
825E      2C                    INR     L
825F      73                    MOV     M,E
8260      E5                    PUSH    H
8261      21 61 04              LXI     H,LEN
8264      35                    DCR     M
8265      2D                    DCR     L
8266      35                    DCR     M
8267      E1                    POP     H
8268      C2 4E 82              JNZ     CVB1
826B      E1          CVB2:     POP     H
826C      F1                    POP     PSW
826D      C1                    POP     B
826E      21 61 04              LXI     H,LEN
8271      4E                    MOV     C,M
```

```
8272      E1                   POP    H
8273      C9                   RET
                   ; ROUTINE TO EVALUATE LENGTH OF ASCII NUMERIC
                   ; CHAR STRING: PASSED ADD OF FIRST CHAR IN HL REG.
                   ; RETURNS LENGTH IN REG A.
8274      C5       LENGTH:     PUSH   B
8275      E5                   PUSH   H
8276      06 00                MVI    B,0
8278      CD 17 82 NLE1:       CALL   NUMB
827B      D2 87 82             JNC    NLE2
827E      23                   INX    H
827F      04                   INR    B
8280      0D                   DCR    C
8281      CA 87 82             JZ     NLE2
8284      C3 78 82             JMP    NLE1
8287      78       NLE2:       MOV    A,B
8288      E1                   POP    H
8289      C1                   POP    B
828A      C9                   RET
                   ; ROUTINE TO LOCATE SOURCE LINE IN MEM. PASSED BIN VALUE
                   ;OF LINE NUMBER IN DE(LOW,HIGH) REG. RETURNS ADDRESS OF
                   ;SOURCE LINE IN HL REGS.(HIGH,LOW). CY SET=@ NOT FOUND.
828B      2A 49 04 NSRCH:      LHLD   STLINE
828E      CD A6 82 L2:         CALL   CHK1
8291      D8                   RC
8292      46                   MOV    B,M
8293      23                   INX    H
8294      4E                   MOV    C,M
8295      CD F1 97             CALL   DCOMP
8298      CA A3 82             JZ     FOUND
829B      23                   INX    H
829C      7E                   MOV    A,M
829D      23                   INX    H
829E      66                   MOV    H,M
829F      6F                   MOV    L,A
82A0      C3 8E 82             JMP    L2
82A3      2B       FOUND:      DCX    H
82A4      B7                   ORA    A
82A5      C9                   RET
                   ; ROUTINE TO COMPARE CONTENTS OF HL TO 177777Q.
                   ; RETURNS CY=1 IF YES: CY=0 IF NO.
```

```
82A6      C5             CHK1:     PUSH    B
82A7      E5                       PUSH    H
82A8      06 00                    MVI     B,0
82AA      0E 01                    MVI     C,1
82AC      09                       DAD     B
82AD      E1                       POP     H
82AE      C1                       POP     B
82AF      C9                       RET
                         ; ROUTINE TO PAD OUTPUT BUFFER WITH CONTENTS OF REG A.
                         ; REG B CONTAINS NUMBER OF CHAR TO PAD.
82B0      C5             PAD:      PUSH    B
82B1      D5                       PUSH    D
82B2      E5                       PUSH    H
82B3      21 00 04                 LXI     H,OBUFF
82B6      4D                       MOV     C,L
82B7      6E                       MOV     L,M
82B8      57                       MOV     D,A
82B9      3E 49                    MVI     A,73
82BB      BD             P1:       CMP     L
82BC      C2 C5 82                 JNZ     P2
82BF      69                       MOV     L,C
82C0      77                       MOV     M,A
82C1      CD D3 82                 CALL    WRIT
82C4      2C                       INR     L
82C5      72             P2:       MOV     M,D
82C6      2C                       INR     L
82C7      05                       DCR     B
82C8      C2 BB 82                 JNZ     P1
82CB      7A                       MOV     A,D
82CC      45                       MOV     B,L
82CD      69                       MOV     L,C
82CE      70                       MOV     M,B
82CF      E1                       POP     H
82D0      D1                       POP     D
82D1      C1                       POP     B
82D2      C9                       RET
                         ; ROUTINE TO DUMP OUTPUT BUFFER TO TTY.
82D3      16 00          WRIT:     MVI     D,0
82D5      F5             WRIT1:    PUSH    PSW
82D6      E5                       PUSH    H
82D7      C5                       PUSH    B
```

```
82D8    21 00 04                LXI     H,OBUFF
82DB    E5                      PUSH    H
82DC    4E                      MOV     C,M
82DD    0D                      DCR     C
82DE    CA F9 82                JZ      W2
82E1    2C                      INR     L
82E2    7E              W1:     MOV     A,M
82E3    CD 07 01                CALL    CONOUT          ;PRINT VIA ODT
82E6    2C                      INR     L
82E7    0D                      DCR     C
82E8    C2 E2 82                JNZ     W1
82EB    15                      DCR     D
82EC    CA F9 82                JZ      W2
82EF    3E 8D                   MVI     A,215Q
82F1    CD 07 01                CALL    CONOUT          ;PRINT VIA ODT
82F4    3E 8A                   MVI     A,212Q
82F6    CD 07 01                CALL    CONOUT          ;PRINT VIA ODT
82F9    E1              W2:     POP     H
82FA    36 01                   MVI     M,1
82FC    C1                      POP     B
82FD    E1                      POP     H
82FE    F1                      POP     PSW
82FF    C9                      RET
                        ; ROUTINE TO LOCATE COMMANDS, KEY WORDS, OPERATORS,
                        ; AND FUNCTION.  HL CONTAINS ADD OF FIRST CHAR.:
                        ; REG C CONTAINS LENGTH OF LINE: RETURNS SYMBOL NUMBER
                        ; IF FOUND IN REG A, 377Q IN A IF NOT FOUND.
8300    D5              SYMSRT: PUSH    D
8301    C5                      PUSH    B
8302    E5                      PUSH    H
8303    E5                      PUSH    H
8304    21 61 04                LXI     H,LEN           ;SAVE C IN LEN
8307    71                      MOV     M,C
8308    21 54 83                LXI     H,KDATA         ;LOCATE TYPE OF SYMBOL SOUGHT.
830B    1E 00                   MVI     E,0             ;REG A CONTAINS:
830D    85                      ADD     L               ; 0 FOR COMMAND
830E    6F                      MOV     L,A             ; 1 FOR KEYWORD
830F    6E                      MOV     L,M             ; 2 FOR OPERATOR AND DELIMITER
8310    4E              S2:     MOV     C,M             ; 3 FOR FUNCTION
8311    2C              S3:     INR     L
8312    46                      MOV     B,M
```

```
8313    E3                        XTHL
8314    7E                        MOV     A,M
8315    B8                        CMP     B
8316    C2 2C 83                  JNZ     S4
8319    0D                        DCR     C
831A    CA 48 83                  JZ      S5
831D    E5                        PUSH    H
831E    21 61 04                  LXI     H,LEN
8321    35                        DCR     M
8322    E1                        POP     H
8323    CA 2B 83                  JZ      S4A
8326    23                        INX     H
8327    E3                        XTHL
8328    C3 11 83                  JMP     S3
832B    0C              S4A:      INR     C
832C    E1              S4:       POP     H
832D    79                        MOV     A,C
832E    85                        ADD     L
832F    54                        MOV     D,H
8330    E1                        POP     H
8331    C1                        POP     B
8332    C5                        PUSH    B
8333    E5                        PUSH    H
8334    E5                        PUSH    H
8335    21 61 04                  LXI     H,LEN
8338    71                        MOV     M,C
8339    6F                        MOV     L,A
833A    62                        MOV     H,D
833B    7E                        MOV     A,M
833C    1C                        INR     E
833D    4F                        MOV     C,A
833E    3C                        INR     A
833F    C2 11 83                  JNZ     S3
8342    21 61 04                  LXI     H,LEN
8345    34                        INR     M
8346    1E FF                     MVI     E,377Q
8348    7B              S5:       MOV     A,E                ; MOVE SYMBOL NUMBER INTO REG A
8349    21 61 04                  LXI     H,LEN
834C    5E                        MOV     E,M
834D    1D                        DCR     E
834E    E1                        POP     H
```

```
834F     E1                   POP     H
8350     C1                   POP     B
8351     4B                   MOV     C,E                 ;MOVE NUMBER OF CHAR. LEFT IN
8352     D1                   POP     D                   ;LINE INT
8353     C9                   RET
                     ;*****************************************************
                     ;THE CODE FROM HERE TO THE NEXT LINE OF *'S MUST BE ON ONE PAGE
                     ;THIS MACRO ADDS PARITY BITS TO CHARACTERS
          1          CHPAR    MACRO   CH
          1                   DB      CH OR 200Q
                              ENDM
8354     58          KDATA:   DB      KDAT1 AND 377Q
8355     6D                   DB      KDAT2 AND 377Q
8356     A7                   DB      KDAT3 AND 377Q
8357     C9                   DB      KDAT4 AND 377Q
8358     03 D2 D5 CE KDAT1:  DB      3,322Q,325Q,316Q    ;RUN
835C     03 D0 CC D3          DB      3,320Q,314Q,323Q    ;PLS
8360     03 CC C9 D3          DB      3,314Q,311Q,323Q    ;LIS
8364     03 D3 C3 D2          DB      3,323Q,303Q,322Q    ;SCR
8368     03 D0 D4 C1          DB      3,320Q,324Q,301Q    ;PTA
836C     FF                   DB      377Q
836D     03 CC C5 D4 KDAT2:  DB      3,314Q,305Q,324Q    ;LET
8371     03 D0 D2 C9          DB      3,320Q,322Q,311Q    ;PRI
8375     03 D2 C5 CD          DB      3,322Q,305Q,315Q    ;REM
8379     03 D3 D4 CF          DB      3,323Q,324Q,317Q    ;STO
837D     03 C5 CE C4          DB      3,305Q,316Q,304Q    ;END
8381     03 C7 CF D4          DB      3,307Q,317Q,324Q    ;GOT
8385     02 C9 C6             DB      2,311Q,306Q         ;IF
8388     03 C9 CE D0          DB      3,311Q,316Q,320Q    ;INP
838C     03 C4 C9 CD          DB      3,304Q,311Q,315Q    ;DIM
8390     03 C3                DB      3,'C'+200Q          ;CAL
8392     C1                   DB      'A'+200Q
8393     CC                   DB      'L'+200Q
8394     04 C7                DB      4,'G'+200Q          ;GOSU
8396     CF                   DB      'O'+200Q
8397     D3                   DB      'S'+200Q
8398     D5                   DB      'U'+200Q
8399     03 D2                DB      3,'R'+200Q          ;RET
839B     C5                   DB      'E'+200Q
839C     D4                   DB      'T'+200Q
839D     03 C6                DB      3,'F' OR 200Q       ;FOR
```

```
839F       CF                           DB      'Ø' ØR 200Q
83A0       D2                           DB      'R' ØR 200Q
83A1       04 CE                        DB      4,'N' ØR 200Q     ;NEXT
83A3       C5                           DB      'E' ØR 200Q
83A4       D8                           DB      'X' ØR 200Q
83A5       D4                           DB      'T' ØR 200Q
83A6       FF                           DB      377Q
                           ;DELIMITERS HAVE FOLLØWING VALUES:
                           ;
                           ;            <       0
                           ;            >       1
                           ;            ,       2
                           ;            =       3
                           ;            )       4
                           ;            ;       5
                           ;            THEN    6
                           ;            TØ      7
                           ;            STEP    8
                           ;            *       9
                           ;            /       10
                           ;            +       11
                           ;            -       12
                           ;
83A7       01 BC 01 BE     KDAT3:     DB      1,274Q,1,276Q     ;'<','>'
83AB       01 AC 01 BD                DB      1,254Q,1,275Q     ;',','='
83AF       01 A9                      DB      1,251Q            ;')'
83B1       01 BB                      DB      1,';'+200Q        ;';'
83B3       04                         DB      4                 ;THEN
         1                 +          CHPAR   '''T'''
83B4     1 D4              +          DB      'T' ØR 200Q
         1                 +          CHPAR   '''H'''
83B5     1 C8              +          DB      'H' ØR 200Q
         1                 +          CHPAR   '''E'''
83B6     1 C5              +          DB      'E' ØR 200Q
         1                 +          CHPAR   '''N'''
83B7     1 CE              +          DB      'N' ØR 200Q
83B8       02                         DB      2                 ;TØ
         1                 +          CHPAR   '''T'''
83B9     1 D4              +          DB      'T' ØR 200Q
         1                 +          CHPAR   '''Ø'''
83BA     1 CF              +          DB      'Ø' ØR 200Q
```

```
83BB      04                        DB      4                  ;STEP
        1               +           CHPAR   '''S'''
83BC    1 D3            +           DB      'S' ØR 200Q
        1               +           CHPAR   '''T'''
83BD    1 D4            +           DB      'T' ØR 200Q
        1               +           CHPAR   '''E'''
83BE    1 C5            +           DB      'E' ØR 200Q
        1               +           CHPAR   '''P'''
83BF    1 D0            +           DB      'P' ØR 200Q
83C0      01 AA                     DB      1,'*'+200Q         ;'*'
83C2      01 AF 01 AB               DB      1,257Q,1,253Q      ;'/','+'
83C6      01 AD                     DB      1,255Q             ;'-'
83C8      FF                        DB      377Q
83C9      03 C7 C5 D4     KDAT4:   DB      3,307Q,305Q,324Q   ;GET
83CD      03 D0 D5 D4               DB      3,320Q,325Q,324Q   ;PUT
83D1      FF                        DB      377Q
                          ;*********************************************************
                          ; RØUTINE TØ INPUT SØURCE LINE FRØM TTY. PASSED ADD
                          ; ØF FIRST CHAR IN HL. RETURNS LENGTH ØF LINE IN REG A
83D2      E5              TTYIN:    PUSH    H
83D3      06 00                     MVI     B,0
83D5      CD F7 97        TIN1:     CALL    CHAR2
83D8      FE 99                     CPI     231Q               ;CNTRL Y?
83DA      CA 0C 84                  JZ      TIN5
83DD      FE FF                     CPI     377Q               ;RUBØUT?
83DF      CA FF 83                  JZ      TIN2
83E2      FE DF                     CPI     337Q               ;BACK ARRØW (RUBØUT)?
83E4      CA 02 84                  JZ      TIN2+3
83E7      FE 8A                     CPI     212Q               ;LF?
83E9      CA D5 83                  JZ      TIN1
83EC      FE 8D                     CPI     215Q               ;CR
83EE      CA 15 84                  JZ      TIN4
83F1      FE 8C                     CPI     214Q               ;FØRM FEED?
83F3      CA D5 83                  JZ      TIN1               ;IGNØRE
83F6      77                        MØV     M,A
83F7      23                        INX     H
83F8      04                        INR     B
83F9      CD 1D 85                  CALL    MEMFUL
83FC      C3 D5 83                  JMP     TIN1
83FF      3E DF           TIN2:     MVI     A,337Q
8401      CD 07 01                  CALL    CØNØUT             ;PRINT VIA ØDT
```

```
8404      2B                     DCX     H
8405      05                     DCR     B
8406      F2 D5 83               JP      TIN1
8409      E1                     POP     H
840A      AF                     XRA     A                   ;ZERO A
840B      C9                     RET
840C      3E DC          TIN5:   MVI     A,334Q
840E      CD 07 01               CALL    CONOUT              ;PRINT VIA ODT
8411      3E 00          TIN5A:  MVI     A,0
8413      E1                     POP     H
8414      C9                     RET
8415      3E 8A          TIN4:   MVI     A,212Q
8417      CD 07 01               CALL    CONOUT              ;PRINT VIA ODT
841A      0E 00          TIN4A:  MVI     C,0
841C      E1                     POP     H
841D      78                     MOV     A,B
841E      B9                     CMP     C
841F      C8                     RZ
                         ;ROUTINE TO REMOVE BLANKS FROM SOURCE UNLESS ENCLOSED IN
8420      D5                     PUSH    D                   ;SAVE REG'S
8421      E5                     PUSH    H
8422      E5                     PUSH    H
8423      1E A2                  MVI     E,'"'+200Q          ;INIT E FOR COMPARES
8425      16 00                  MVI     D,0                 ;D=1=>WITHIN QUOTES, LEAVE BLANKS
8427      AF             PK1:    XRA     A                   ;CLEAR A
8428      BA                     CMP     D                   ;CHECK INPUT MODE
8429      7E                     MOV     A,M                 ;GET CHAR
842A      C2 3A 84               JNZ     QSTRG               ;WITHIN QUOTE STRING
842D      BB                     CMP     E                   ;IS IT 1ST
842E      C2 35 84               JNZ     $+7                 ;NO - PROCEED
8431      14                     INR     D                   ;YES, SET FLAG
8432      C3 3F 84               JMP     QSTR1               ;CONTINUE
8435      FE A0                  CPI     240Q                ;IS IT A SPACE?
8437      CA 44 84               JZ      PK2                 ;YES - LEAVE OUT
843A      BB             QSTRG:  CMP     E                   ;2ND "?
843B      C2 3F 84               JNZ     $+4                 ;NO - CONTINUE
843E      15                     DCR     D                   ;RESET FLAG
843F      E3             QSTR1:  XTHL                        ;GET DESTINATION ADDRESS
8440      77                     MOV     M,A                 ;SAVE
8441      23                     INX     H                   ;BUMP PNTR.
```

```
8442    E3                          XTHL                ;GET SOURCE ADD.
8443    0C                          INR     C           ;BUMP CHAR. CNT
8444    23              PK2:        INX     H           ;BUMP PNTR.
8445    05                          DCR     B           ;DCR INPUT LINE CHAR CNT
8446    C2 27 84                    JNZ     PK1         ;MORE - GO AGAIN
8449    79                          MOV     A,C         ;CHAR CNT TO A
844A    E1                          POP     H           ;RESTORE REG'S, RETURN
844B    E1                          POP     H
844C    D1                          POP     D
844D    C9                          RET
                        ; ROUTINES TO  PAD MESSAGES TO  OUTPUT BUFFER.
                        ; FOR12 PADS 'UNDERFLOW'
                        ; FOR11 PADS 'OVERFLOW'
                        ; FOR10 PADS 'ZERODIVIDE'
                        ; FORM9 PADS 'INPUT ERROR, TRY AGAIN'
                        ; FORM8 PADS 'MEMORY FULL'
                        ; FORM7 PADS 'WHAT?'
                        ; FORM4 PADS 'IN LINE'
                        ; FORM3 PADS 'ERROR'
                        ; FORM2 PADS 'TURN ON PUNCH'
                        ; FORM1 PADS 'READY'
                        ; FORM5 PADS SOURCE LINE, PASSED ADDRESS OF
                        ; LENGTH OF LINE IN HL REGS.
                        ; FORM6 PADS CHAR STRING, PASSED ADD OF FIRST CHAR IN
                        ; HL, LENGTH OF STRING IN REG C
844E    2C              FOR12:      INR     L
844F    2C              FOR11:      INR     L
8450    2C              FOR10:      INR     L
8451    2C              FORM9:      INR     L
8452    2C              FORM8:      INR     L
8453    2C              FORM7:      INR     L
8454    2C              FORM4:      INR     L
8455    2C              FORM3:      INR     L
8456    2C              FORM2:      INR     L
8457    6E              FORM1:      MOV     L,M
8458    4E              FORM5:      MOV     C,M
8459    79                          MOV     A,C
845A    FE 00                       CPI     0
845C    C8                          RZ
845D    23              F1:         INX     H
845E    7E              FORM6:      MOV     A,M
```

```
845F      06 01                    MVI     B,1
8461      CD B0 82                 CALL    PAD
8464      0D                       DCR     C
8465      C2 5D 84                 JNZ     F1
8468      C9                       RET
                        ;*****************************************************
                        ;THE CODE FROM HERE TO THE NEXT LINE OF *'S MUST BE ON ONE PAGE
8469      73            ODATA:     DB      ODAT1 AND 377Q
846A      79                       DB      ODAT2 AND 377Q
846B      87                       DB      ODAT3 AND 377Q
846C      90                       DB      ODAT4 AND 377Q
846D      9A                       DB      ODAT5 AND 377Q
846E      A0                       DB      ODAT6 AND 377Q
846F      AF                       DB      ODAT7 AND 377Q
8470      C6                       DB      ODAT8 AND 377Q
8471      D1                       DB      ODAT9 AND 377Q
8472      DA                       DB      ODA10 AND 377Q
8473      05 52 45 41   ODAT1:     DB      5,'READY'
8477      44 59
8479      0D 54 55 52   ODAT2:     DB      13,'TURN ON PUNCH'
847D      4E 20 4F 4E
8481      20 50 55 4E
8485      43 48
8487      08 8D 8A 45   ODAT3:     DB      8,215Q,212Q,'ERROR '
848B      52 52 4F 52
848F      20
8490      09 20 49 4E   ODAT4:     DB      9,' IN LINE '
8494      20 4C 49 4E
8498      45 20
849A      05 57 48 41   ODAT5:     DB      5,'WHAT?'
849E      54 3F
84A0      0E 4D 45 4D   ODAT6:     DB      14,'MEMORY FULL',215Q,212Q,'?'
84A4      4F 52 59 20
84A8      46 55 4C 4C
84AC      8D 8A 3F
84AF      16 49 4E 50   ODAT7:     DB      22,'INPUT ERROR, TRY AGAIN'
84B3      55 54 20 45
84B7      52 52 4F 52
84BB      2C 20 54 52
84BF      59 20 41 47
84C3      41 49 4E
```

```
84C6       0A 49 4E 44     ODAT8:     DB       10,'INDEFINITE'
84CA       45 46 49 4E
84CE       49 54 45
84D1       08 4F 56 45     ODAT9:     DB       8,'OVERFLOW'
84D5       52 46 4C 4F
84D9       57
84DA       09 55 4E 44     ODA10:     DB       9,'UNDERFLOW'
84DE       45 52 46 4C
84E2       4F 57
                           ;*************************************************
                           ; ROUTINE TO INPUT SOURCE LINE FROM HSR. PASSED ADD
                           ; OF FIRST CHAR IN HL. RETURNS LENGTH OF LINE IN REG A
84E4       E5              HSRIN:     PUSH     H
84E5       06 00                      MVI      B,0
84E7       C3 ED 84                   JMP      PIN1A
84EA       CD 17 85        PIN1:      CALL     CHAR5
84ED       FE 99           PIN1A:     CPI      231Q              ;CNTRL Y?
84EF       CA 11 84                   JZ       TIN5A
84F2       FE FF                      CPI      377Q
84F4       CA 0F 85                   JZ       PIN3
84F7       FE DF                      CPI      337Q
84F9       CA 0F 85                   JZ       PIN3
84FC       FE 8A                      CPI      212Q
84FE       CA 1A 84                   JZ       TIN4A
8501       FE 8D                      CPI      215Q
8503       CA EA 84                   JZ       PIN1
8506       77                         MOV      M,A
8507       23                         INX      H
8508       04                         INR      B
8509       CD 1D 85                   CALL     MEMFUL
850C       C3 EA 84                   JMP      PIN1
850F       2B              PIN3:      DCX      H
8510       05                         DCR      B
8511       F2 EA 84                   JP       PIN1
8514       E1                         POP      H
8515       AF                         XRA      A                 ;ZERO A
8516       C9                         RET
                           ; ROUTINE TO INPUT CHAR FROM HSR
8517       C5              CHAR5:     PUSH     B
8518       CD 0D 01                   CALL     HSRDR
851B       C1                         POP      B
```

```
851C     C9                  RET
                     ; ROUTINE TO INSURE SOURCE DOES NOT OVERFLOW MEM SPACE
                     ; COMPARES CURENT MEM ADDRESS TO SP.
851D     C5          MEMFUL:  PUSH   B
851E     D5                   PUSH   D
851F     E5                   PUSH   H
8520     3E 32                MVI    A,50
8522     85                   ADD    L
8523     47                   MOV    B,A
8524     3E 00                MVI    A,0
8526     8C                   ADC    H
8527     4F                   MOV    C,A
8528     21 00 00             LXI    H,0
852B     39                   DAD    SP
852C     55                   MOV    D,L
852D     5C                   MOV    E,H
852E     CD F1 97             CALL   DCOMP
8531     E1                   POP    H
8532     D1                   POP    D
8533     C1                   POP    B
8534     D0                   RNC
8535     21 69 84             LXI    H,ODATA
8538     CD 52 84             CALL   FORM8
853B     CD D3 82             CALL   WRIT
853E     CD F7 97             CALL   CHAR2
8541     CD B0 82             CALL   PAD
8544     CD D3 82             CALL   WRIT
8547     DE B0                SBI    260Q
8549     FE 04                CPI    4
854B     CC 9F 81             CZ     WHAT
854E     2A 00 01             LHLD   SPNT
8551     F9                   SPHL
8552     0E 01                MVI    C,1
8554     C3 48 80             JMP    M4A
                     ; ROUTINE TO EVALUATE BOUNDS FOR LIST AND PLIST
                     ; COMMANDS. RETURNS PLINE AS FIRST LINE, KLINE
                     ; AS LAST LINE TO BE LISTED.
8557     2A 4B 04    BOUND:   LHLD   NLINE
855A     3E 09                MVI    A,9
855C     85                   ADD    L
855D     6F                   MOV    L,A
```

```
855E        3E 00                  MVI    A,0
8560        8C                     ADC    H
8561        67                     MØV    H,A
8562        E5                     PUSH   H
8563        CD 17 82               CALL   NUMB
8566        D4 9F 81               CNC    WHAT
8569        CD 2D 82               CALL   CVB
856C        F5                     PUSH   PSW
856D        C5                     PUSH   B
856E        CD AD 85               CALL   BND2
8571        C1                     PØP    B
8572        2B                     DCX    H
8573        22 59 04               SHLD   PLINE
8576        F1             BND1:   PØP    PSW
8577        E1                     PØP    H
8578        3C                     INR    A
8579        85                     ADD    L
857A        6F                     MØV    L,A
857B        3E 00                  MVI    A,0
857D        8C                     ADC    H
857E        67                     MØV    H,A
857F        3E 00                  MVI    A,0
8581        B9                     CMP    C
8582        C8                     RZ
8583        0D                     DCR    C
8584        CD 17 82               CALL   NUMB
8587        D4 9F 81               CNC    WHAT
858A        D5                     PUSH   D
858B        CD 2D 82               CALL   CVB
858E        D5                     PUSH   D
858F        C5                     PUSH   B
8590        CD AD 85               CALL   BND2
8593        C1                     PØP    B
8594        23                     INX    H
8595        56                     MØV    D,M
8596        23                     INX    H
8597        5E                     MØV    E,M
8598        EB                     XCHG
8599        22 52 04               SHLD   KLINE
859C        D1                     PØP    D
859D        E1                     PØP    H
```

```
859E     79                    MOV     A,C
859F     FE 00                 CPI     0
85A1     C2 9F 81              JNZ     WHAT
85A4     44                    MOV     B,H
85A5     4D                    MOV     C,L
85A6     CD F1 97              CALL    DCOMP
85A9     D0                    RNC
85AA     C3 9F 81              JMP     WHAT
85AD     2A 49 04      BND2:   LHLD    STLINE
85B0     46            BND3:   MOV     B,M
85B1     23                    INX     H
85B2     4E                    MOV     C,M
85B3     CD F1 97              CALL    DCOMP
85B6     D8                    RC
85B7     C8                    RZ
85B8     E5                    PUSH    H
85B9     23                    INX     H
85BA     7E                    MOV     A,M
85BB     23                    INX     H
85BC     66                    MOV     H,M
85BD     6F                    MOV     L,A
85BE     CD A6 82              CALL    CHK1
85C1     C1                    POP     B
85C2     D2 B0 85              JNC     BND3
85C5     C5                    PUSH    B
85C6     E1                    POP     H
85C7     C9                    RET
                       ; ROUTINE TO OUTPUT ERROR MSG. TO USER.
                       ; REG A CONTAINS BCD ERROR NUMBER, HL
                       ; LOADED WITH VALUE OF KLINE.
85C8     21 13 80      ERROR:  LXI     H,M1A           ;RETURN ADDRESS
85CB     E5                    PUSH    H               ;PUT ON STACK
85CC     21 69 84              LXI     H,ODATA         ;OUTPUT BUFFER DATA TABLES
85CF     E5                    PUSH    H
85D0     57                    MOV     D,A             ;SAVE ERROR NUMB. IN D
85D1     CD 55 84              CALL    FORM3           ;PAD 'ERROR '
85D4     06 01                 MVI     B,1             ;INIT FOR PADS
85D6     48                    MOV     C,B             ;INIT AS CNTR.
85D7     7A                    MOV     A,D             ;GET ERROR NUMB.
85D8     07                    RLC                     ;ROTATE HIGH 4 BITS TO LOW 4
85D9     07                    RLC
```

```
85DA    07                        RLC
85DB    07                        RLC
85DC    E6 0F          ERRR1:     ANI     17Q                ;MASK
85DE    C6 B0                     ADI     260Q               ;CONVERT TO ASCII
85E0    CD B0 82                  CALL    PAD                ;PAD IT
85E3    7A                        MOV     A,D                ;GET ERROR NUMB.
85E4    0D                        DCR     C                  ;ANOTHER PASS?
85E5    F2 DC 85                  JP      ERRR1              ;YES
85E8    E1                        POP     H                  ;NO-CONTINUE
85E9    CD 54 84       ERLN:      CALL    FORM4
85EC    2A 52 04                  LHLD    KLINE
85EF    23                        INX     H
85F0    23                        INX     H
85F1    23                        INX     H
85F2    23                        INX     H
85F3    4E                        MOV     C,M
85F4    23                        INX     H
85F5    CD 74 82                  CALL    LENGTH
85F8    4F                        MOV     C,A
85F9    CD 5E 84                  CALL    FORM6
85FC    CD D3 82                  CALL    WRIT
85FF    C9                        RET
                       ;THIS ROUTINE INCREMENTS H AND L AND
                       ;DECR. C(CHARS IN LINE) SHOULD C RESULT
                       ;IN 0 THEN THE ERROR CORRES. TO ENTRY PNT.
                       ;IS GIVEN
8600    3E 07          ICP7:      MVI     A,7
8602    C3 11 86                  JMP     INCPT
8605    3E 08          ICP8:      MVI     A,8
8607    C3 11 86                  JMP     INCPT
860A    3E 04          ICP4:      MVI     A,4
860C    C3 11 86                  JMP     INCPT
860F    3E 02          ICP2:      MVI     A,2
8611    23             INCPT:     INX     H
8612    0D                        DCR     C
8613    C0                        RNZ
8614    C3 C8 85                  JMP     ERROR
                       ;FSYM FINDS SYMBOLS IN TABLE
                       ;B,C CONTAIN SYMBOL
                       ;RET WITH B,C,D,E SAME
                       ;H AND L PNT TO VALUE (1ST BYTE)
```

```
                        ;CY=1   =@ FOUND
                        ;CY=0   AND A SCALAR VAR. =@ INSERTED
                        ;    AND SET TO 0
                        ;CY=0   AND AN ARRAY  =@ NO ACTION,
                        ;     H AND L PNT TO LAST ENTRY IN SYMBOL TABLE
8617    D5              FSYM:   PUSH    D
8618    AF                      XRA     A
8619    B0                      ORA     B               ;SET CARRY IF NOT
861A    CA 1E 86                JZ      AR              ;AN ARRAY AND SAVE
861D    3F                      CMC
861E    F5              AR:     PUSH    PSW
861F    2A 59 04                LHLD    NXTSP           ;GET NEXT AVAILABLE
8622    C5                      PUSH    B               ;SPACE PNTR.
8623    44                      MOV     B,H
8624    4D                      MOV     C,L             ;CHECK TO SEE
8625    2A 4B 04                LHLD    STSPAC          ;IF SYMBOL TABLE
8628    54                      MOV     D,H             ;EMPTY
8629    5D                      MOV     E,L
862A    CD F1 97                CALL    DCOMP           ;DOUBLE BYTE COMPARE
862D    C1                      POP     B               ;GET VAR. BACK
862E    CA 4E 86                JZ      NOSYM
8631    CD A6 82        LUKON:  CALL    CHK1            ;CHECK FOR END
8634    DA 50 86                JC      NOENT
8637    54                      MOV     D,H             ;SAVE OLD PNTR
8638    5D                      MOV     E,L
8639    78                      MOV     A,B
863A    BE                      CMP     M               ;DO VARIABLES MATCH
863B    C2 45 86                JNZ     NOMAT
863E    23                      INX     H
863F    79                      MOV     A,C
8640    BE                      CMP     M
8641    CA 7E 86                JZ      ENTRY
8644    2B                      DCX     H
8645    23              NOMAT:  INX     H               ;NO MATCH GET NEW PNT.
8646    23                      INX     H
8647    7E                      MOV     A,M
8648    23                      INX     H
8649    66                      MOV     H,M
864A    6F                      MOV     L,A
864B    C3 31 86                JMP     LUKON
                        ;ARRIVE HERE IF SYMBOL TABLE IS EMPTY
```

```
864E    1B              NOSYM:   DCX    D        ; =STSPAC-2 SO STPNT WORKS RIGHT
864F    1B                       DCX    D
                        ;ARRIVE HERE WHEN NO ENTRY FOUND
8650    2A 59 04        NOENT:   LHLD   NXTSP    ;ADD. OF FREE MEMORY
8653    EB                       XCHG            ;TO DE, HL HAVE LAST SYM. TAB.
8654    F1                       POP    PSW      ;ENTRY ARRAY?
8655    D2 83 86                 JNC    FBAC     ;YES, RETURN
8658    CD BA 8F                 CALL   CHKLC    ;CHECK FOR PAGE BOUNDARY CROSSING
865B    CD 8C 81                 CALL   STPNT    ;UPDATE PNTR
865E    EB                       XCHG            ;NXTSP TO HL
865F    70                       MOV    M,B      ;STORE VAR.
8660    23                       INX    H
8661    71                       MOV    M,C
8662    23                       INX    H
8663    E5                       PUSH   H
8664    23                       INX    H        ;STORE NXTSP+8 IN NXTSP
8665    23                       INX    H
8666    23                       INX    H
8667    23                       INX    H
8668    23                       INX    H
8669    23                       INX    H
866A    22 59 04                 SHLD   NXTSP
866D    CD 1D 85                 CALL   MEMFUL   ;MEMORY FULL?
8670    E1                       POP    H        ;SET FWD PNT. TO -1
8671    36 FF                    MVI    M,377Q
8673    23                       INX    H
8674    36 FF                    MVI    M,377Q
8676    23                       INX    H        ;INIT TO FLT. PNT. 0
8677    CD CD 97                 CALL   ZROL
867A    B7                       ORA    A        ;CLEAR CY
867B    C3 83 86                 JMP    FBAC     ;RESET CARRY AND RETURN
867E    F1              ENTRY:   POP    PSW      ;VAR FOUND
867F    23                       INX    H        ;MOVE PNT. TO FIRST BYTE
8680    23                       INX    H        ;OF FLT. PNT. NO.
8681    23                       INX    H
8682    37                       STC             ;SET CY AND RET.
8683    D1              FBAC:    POP    D        ;RESTORE D
8684    C9                       RET
                        ;
                        ;
                        ;RUN - THE INTERP.
```

```
                            ;
                            ;
                            ;INIT. NXTSP
8685      2A 4B 04          RUN:      LHLD    STSPAC
8688      EB                          XCHG
8689      CD CB 8F                    CALL    CKDIM         ; ADJUST START OF SYMBOL TABLE SO
                                                            ; IT STARTS ON AN EVEN 4 WORD BOUNDARY
868C      CD BA 8F                    CALL    CHKLC         ; ADJUST START OF SYMBOL TABLE SO IT
                                                            ; DOES NOT CROSS PAGE BOUNDARY
868F      EB                          XCHG
8690      22 4B 04                    SHLD     STSPAC
8693      22 59 04                    SHLD    NXTSP
8696      21 AA 04                    LXI     H,BOTNS       ;INIT SP FOR NESTING STACK
8699      22 94 04                    SHLD    NEST
869C      21 13 80                    LXI     H,M1A         ;PRECAUTION, IN CASE RETURN IS
869F      E5                          PUSH    H             ;EXECUTED BEFORE A GOSUB
86A0      E5                          PUSH    H
86A1      2A 49 04                    LHLD    STLINE        ;START OF SOURCE
86A4      CD 09 82          ILOOP:    CALL    QUITT         ;CHECK FOR INTERRUPTION
86A7      CD A6 82                    CALL    CHK1          ;HL=-1 =@ NO MORE SOURCE
86AA      D2 B2 86                    JNC     SORCE
86AD      3E 01                       MVI     A,1
86AF      C3 C8 85                    JMP     ERROR         ;ERROR 1, NO END STMT.
86B2      22 52 04          SORCE:    SHLD    LPNT
86B5      E5                          PUSH    H
86B6      21 52 04                    LXI     H,LPNT        ;DEFINE VALUES OF
86B9      CD EE 97                    CALL    PTVAL         ;KBIN,KFPNT,KLEN
86BC      3A 58 04                    LDA     KLEN          ;CHAR'S IN LINE TO C
86BF      4F                          MOV     C,A
86C0      0C                          INR     C
86C1      E1                          POP     H             ;MOVE PNTR. TO 1ST CHAR
86C2      23                          INX     H             ;IN SOURCE REC.
86C3      23                          INX     H
86C4      23                          INX     H
86C5      23                          INX     H
86C6      CD 0F 86          L1:       CALL    ICP2          ;INCR. H,L DCR C
86C9      CD 25 82                    CALL    ALPHA         ;FIND FIRST LETTER
86CC      D2 C6 86                    JNC     L1
86CF      AF                          XRA     A
86D0      3C                          INR     A             ;LETTER FOUND
86D1      CD 00 83                    CALL    SYMSRT        ;DETERMINE KEYWORD
```

```
86D4    FE FF             CPI     377Q
86D6    C2 DE 86          JNZ     GKEY
86D9    3E 02             MVI     A,2             ;BAD KEYWORD
86DB    C3 C8 85          JMP     ERROR
86DE    22 5B 04   GKEY:  SHLD    CPNT
86E1    21 EE 86          LXI     H,JTBL          ;LOAD JUMP TABLE PNTR.
86E4    87                ADD     A               ;DOUBLE A
86E5    5F                MOV     E,A
86E6    16 00             MVI     D,0
86E8    19                DAD     D               ;PNT. TO PROPER PROC.
86E9    7E                MOV     A,M             ;ADD. IN JUMP TABLE
86EA    23                INX     H               ;GET PROC. ADD.
86EB    66                MOV     H,M
86EC    6F                MOV     L,A
86ED    E9                PCHL                    ;INDIRECT JUMP TO PROC.
86EE    FD 8B      JTBL:  DW      LET             ;JMP TABLE
86F0    B5 8A             DW      PRI
86F2    AC 8B             DW      IEND            ;REM STMT. - NO ACTION
86F4    13 80             DW      M1A             ;STOP STMT.-RETURN TO EDIT MODE
86F6    0A 87             DW      ENDD
86F8    18 87             DW      GOTO
86FA    9D 8C             DW      IFRT
86FC    6C 8B             DW      INPUT
86FE    38 87             DW      DIM
8700    7A 8D             DW      CALLP
8702    F0 8D             DW      GOSUB
8704    05 8E             DW      RETRN
8706    07 8E             DW      FOR
8708    F9 8E             DW      NEXT
870A    2A 56 04   ENDD:  LHLD    KFPNT           ;CHECK TO SEE IF MORE
870D    CD A6 82          CALL    CHK1            ;SOURCE AFTER END
8710    DA 13 80          JC      M1A
8713    3E 03             MVI     A,3             ;MORE SOURCE ERROR 3
8715    C3 C8 85          JMP     ERROR
8718    2A 5B 04   GOTO:  LHLD    CPNT            ;GOTO STMT. PROC.
871B    23         GSENT: INX     H               ;INCREMENT PAST KEYWORD
871C    23                INX     H
871D    23                INX     H
871E    CD 0A 86          CALL    ICP4            ;POSSIBLE ERROR 4
8721    CD 2D 82   GTRA:  CALL    CVB             ;GET DESTINATION
8724    B7                ORA     A               ;MAKE SURE IT WAS OK
```

```
8725      C2 2D 87                JNZ     OKN
8728      3E 04                   MVI     A,4
872A      C3 C8 85                JMP     ERROR
872D      CD 8B 82     OKN:       CALL    NSRCH             ;GET NEXT LPNT
8730      D2 A4 86                JNC     ILOOP             ;MAKE SURE IT EXISTED
8733      3E 05                   MVI     A,5
8735      C3 C8 85                JMP     ERROR             ;NON-EXISTENT
8738      2A 5B 04     DIM:       LHLD    CPNT              ;DIM STMT. PROC.
873B      23                      INX     H                 ;PNT TO FIRST VAR.
873C      23                      INX     H
873D      23                      INX     H
873E      CD 25 82     DLOOP:     CALL    ALPHA             ;CHECK IF IT IS A VAR.
8741      DA 49 87                JC      OKLET
8744      3E 06        ER6:       MVI     A,6               ;ERROR 6
8746      C3 C8 85                JMP     ERROR
8749      46           OKLET:     MOV     B,M
874A      CD 00 86                CALL    ICP7              ;INCR.CPNT
874D      3E A8                   MVI     A,250Q            ;CHECK FOR (
874F      BE                      CMP     M
8750      C2 44 87                JNZ     ER6
8753      CD 00 86                CALL    ICP7              ;INCR. CPNT
8756      CD 2D 82                CALL    CVB               ;CONV. TO BIN NO.
8759      85                      ADD     L                 ;UPDATE CPNT
875A      6F                      MOV     L,A               ;ED CONTAIN ARRAY LEN.
875B      3E 00                   MVI     A,0
875D      8C                      ADC     H                 ;C CONT. NO. CHARS LEFT
875E      67                      MOV     H,A               ;IN LINE
875F      3E A9                   MVI     A,251Q            ;CHECK FOR )
8761      BE                      CMP     M
8762      C2 44 87                JNZ     ER6
8765      E5                      PUSH    H
8766      C5                      PUSH    B                 ;SAVE B,C,H,L
8767      48                      MOV     C,B               ;SET UP FOR CALL TO FSYM
8768      06 00                   MVI     B,0
876A      CD 17 86                CALL    FSYM
876D      D2 77 87                JNC     NDOU
8770      C1                      POP     B
8771      E1                      POP     H
8772      3E 11                   MVI     A,11H             ;ERROR 11
8774      C3 C8 85                JMP     ERROR             ;DUPLICATE ARRAY DEF.
8777      D5           NDOU:      PUSH    D                 ;SAVE DIM. LENGTH
```

```
8778    EB                      XCHG            ;ADD. OF LAST SYM. TAB. ENTRY TO DE
8779    2A 59 04                LHLD   NXTSP    ;GET ADD. OF AVAILABLE MEM.
877C    EB                      XCHG            ;SET UP FOR CALL
877D    CD CB 8F                CALL   CKDIM    ; CHECK START OF 'DIM' ARRAY
8780    CD 8C 81                CALL   STPNT    ;STORE NEW PNTR
8783    EB                      XCHG            ;NXTSP TO HL
8784    D1                      POP    D        ;RESTORE D
8785    36 00                   MVI    M,0
8787    23                      INX    H        ;INSERT VAR IN SYMB. TAB.
8788    71                      MOV    M,C
8789    23                      INX    H
878A    36 FF                   MVI    M,377Q   ;FPNT TO -1
878C    23                      INX    H
878D    36 FF                   MVI    M,377Q
878F    23                      INX    H        ;PNTS TO FIRST DATA
8790    7A                      MOV    A,D      ;GET ONE'S COMPLEMENT OF
8791    2F                      CMA             ;NUMBER OF ELEMENTS
8792    4F                      MOV    C,A      ;IN ARRAY TO B,C
8793    7B                      MOV    A,E
8794    2F                      CMA
8795    47                      MOV    B,A
8796    CD CD 97        CONT:   CALL   ZROL     ;ZEROE OUT ELEMTS.
8799    23                      INX    H        ; OF ARRAY
879A    23                      INX    H
879B    23                      INX    H
879C    23                      INX    H
879D    03                      INX    B
879E    E5                      PUSH   H
879F    CD 1D 85                CALL   MEMFUL   ;MEMORY FULL?
87A2    60                      MOV    H,B
87A3    69                      MOV    L,C
87A4    CD A6 82                CALL   CHK1
87A7    E1                      POP    H
87A8    D2 96 87                JNC    CONT
87AB    22 59 04                SHLD   NXTSP    ;NEW VALUE OF NXTSP.
87AE    C1                      POP    B        ;RESTORE REG'S
87AF    E1                      POP    H
87B0    23                      INX    H
87B1    0D                      DCR    C        ;MORE ELEMTS IN LINE?
87B2    CA AC 8B                JZ     IEND
87B5    0D                      DCR    C
```

```
87B6    CA 44 87              JZ      ER6
87B9    3E AC                 MVI     A,254Q          ;NEXT ELEMENT A ,
87BB    BE                    CMP     M
87BC    23                    INX     H
87BD    CA 3E 87              JZ      DLOOP
87C0    C3 44 87              JMP     ER6
                     ;ROUTINE TO COPY CONTENTS PNTED TO
                     ;BY DE TO LOCATION H,L
87C3    F5           COPDH:   PUSH    PSW             ;SAVE REGISTERS
87C4    C5                    PUSH    B
87C5    D5                    PUSH    D
87C6    E5                    PUSH    H
87C7    06 04                 MVI     B,4             ;COUNT
87C9    1A           COPD1:   LDAX    D               ;GET FROM SOURCE
87CA    77                    MOV     M,A             ;PUT TO DESTINATION
87CB    13                    INX     D               ;BUMP PNTRS, CNT
87CC    23                    INX     H
87CD    05                    DCR     B
87CE    C2 C9 87              JNZ     COPD1
87D1    E1                    POP     H               ;RESTORE REGISTERS
87D2    D1                    POP     D
87D3    C1                    POP     B
87D4    F1                    POP     PSW
87D5    C9                    RET
                     ;OUTR PADS OUTPUT FROM CONV INTO
                     ;OUTPUT BUFFER USING ROUTINE PAD
                     ;ALL REG'S MAINTAINED
87D6    C5           OUTR:    PUSH    B               ;SAVE REG B
87D7    06 01                 MVI     B,1             ;PAD ONCE
87D9    CD B0 82              CALL    PAD             ;DO IT
87DC    C1                    POP     B               ;RESTORE B AND RET.
87DD    C9                    RET
                     ;VALUE RETURNS IN D(H),E(L) PNTR.
                     ;TO THE VALUE OF A TOKEN
                     ;C,H,L ARE UPDATED
                     ;A,B ARE DESTROYED
87DE    CD 8D 88     VALUE:   CALL    VAR             ;IS IT A VARIABLE?
87E1    D8                    RC                      ;YES - ALL DONE
87E2    3E 03                 MVI     A,3             ;NO CHEK IF A FUNC.
87E4    CD 00 83              CALL    SYMSRT
87E7    FE FF                 CPI     377Q
```

```
87E9    CA 56 88             JZ     KONT          ;NOT A FUNCTION -
87EC    FE 01                CPI    1             ;WAS IT PUT(--)?
87EE    C2 F4 87             JNZ    GET           ;NO - OK
87F1    C3 98 8C             JMP    ER10          ;ILLEGAL USE OF FUNCTION
87F4    23          GET:     INX    H             ;OK, IT'S GET(--)
87F5    23                   INX    H             ;UPDATE H,L
87F6    23                   INX    H
87F7    79                   MOV    A,C           ;CHECK FOR PREMATURE EOL
87F8    B7                   ORA    A
87F9    CA 42 8A             JZ     ER8
87FC    3E A8                MVI    A,250Q        ;CHEK FOR (
87FE    BE                   CMP    M
87FF    C2 42 8A             JNZ    ER8
8802    CD 05 86             CALL   ICP8          ;BUMP PNTR'S
8805    CD E7 89             CALL   EVAL          ;GET PORT =
8808    E5                   PUSH   H             ;SAVE REG H,L
8809    21 7C 04             LXI    H,FREG1
880C    CD C3 87             CALL   COPDH         ;COPY IT
880F    EB                   XCHG
8810    E1                   POP    H             ;RESTORE H,L
8811    CD 35 89             CALL   FIX           ;FIX IT
8814    13                   INX    D
8815    13                   INX    D             ;GET LOWEST BYTE TO
8816    13                   INX    D             ;REG D
8817    1A                   LDAX   D
8818    57                   MOV    D,A
8819    79                   MOV    A,C           ;EOL?
881A    B7                   ORA    A
881B    CA 42 8A             JZ     ER8
881E    3E A9                MVI    A,251Q        ;CHECK FOR )
8820    BE                   CMP    M
8821    C2 42 8A             JNZ    ER8
8824    23                   INX    H             ;BUMP PNTR'S
8825    0D                   DCR    C
8826    E5                   PUSH   H             ;SAVE H,L,B,C
8827    C5                   PUSH   B             ;STORE PROGRAM SEGMENT
8828    01 77 04             LXI    B,GREG        ;IN RAM,START AT GREG
882B    21 51 88             LXI    H,RINST       ;ADD. OF INST'S
882E    1E 05                MVI    E,5           ;NUMB. OF BYTES
8830    7E          V1:      MOV    A,M           ;GET BYTE
8831    02                   STAX   B             ;STORE IN RAM
```

```
8832    23                        INX    H
8833    03                        INX    B
8834    1D                        DCR    E                ;BUMP PNTR'S,DCR CNT
8835    C2 30 88                  JNZ    V1
8838    21 78 04                  LXI    H,GREG+1         ;STORE PORT =
883B    72                        MOV    M,D              ;IN RAM
883C    C3 77 04                  JMP    GREG             ;OK - TRANSFER
883F    21 79 04        HOME:     LXI    H,GREG+2         ;SET UP FOR FLOAT
8842    77                        MOV    M,A              ;STORE AWAY INPUT
8843    2B                        DCX    H
8844    AF                        XRA    A                ;ZERO OUT HIGHER BYTES
8845    77                        MOV    M,A              ;BUT CHAR. DOESN'T MATTER
8846    2B                        DCX    H
8847    77                        MOV    M,A
8848    CD DC 97                  CALL   DFXL             ;FLOAT IT
884B    11 77 04                  LXI    D,GREG           ;FIX D,E RESTORE C,H,L
884E    C1                        POP    B
884F    E1                        POP    H
8850    C9                        RET
8851    DB 00           RINST:    IN     0                ;RAM INSTRUCTIONS
8853    C3 3F 88                  JMP    HOME
8856    CD 17 82        KONT:     CALL   NUMB             ;NUMBER
8859    DA 62 88                  JC     OKK
885C    3E AE                     MVI    A,256Q           ;DEC. PNT.?
885E    BE                        CMP    M
885F    C2 42 8A                  JNZ    ER8
8862    3E 01           OKK:      MVI    A,1              ;MODE=1, IE. INPUT FROM SOURCE
8864    CD 6E 88                  CALL   RDKON            ;READ CONSTANT TO GREG
8867    DA 88 88                  JC     ER9              ;IF ERROR THEN CY=1
886A    11 77 04                  LXI    D,GREG           ;PNTS. TO CONSTANT
886D    C9                        RET
                        ;THIS ROUTINE READS A CONSTANT INTO GREG FROM ASCII
                        ;CHARACTERS POINTED TO BY HL AND C
                        ;ENTER WITH A=0 => DATA FROM TTY
                        ;ENTER WITH A=1 => DATA FROM SOURCE
                        ;RETURN WITH CY=1 => ERROR IN CONVERSION
886E    32 85 04        RDKON:    STA    MODE             ;SAVE MODE FOR ROUT. INP
8871    22 86 04                  SHLD   HLINP            ;SAVE HL FOR ROUT. INP
8874    79                        MOV    A,C
8875    32 84 04                  STA    CREG             ;SAVE C FOR ROUT. INP
8878    21 77 04                  LXI    H,GREG           ;WHER VALUE WILL GO
```

```
887B      0E 66                 MVI     C,SCR AND 377Q      ;SET UP AND CALL FINPT
887D      CD E8 97              CALL    FINPT
8880      2A 86 04              LHLD    HLINP               ;RETORE H,L AND C
8883      3A 84 04              LDA     CREG
8886      4F                    MOV     C,A
8887      C9                    RET                         ;DONE
8888      3E 09         ER9:    MVI     A,9
888A      C3 C8 85              JMP     ERROR
                        ;VAR DECIDES WHETHER A TOKEN IS
                        ;A VARIABLE IF SO CY=1 AND
                        ;ADDRESS IS COMPUTED,(SUBSCRIPT IS
                        ;EVALUATED ETC.), RETURNS WITH DE PNTING
                        ;TO VAR. REFERENCED H,L,C,UPDATED
                        ;A,B DESTROYED
                        ;IF NOT A VARIBLE CY=0
                        ;H,L,C ARE LEFT UNTOUCHED
888D      CD 25 82      VAR:    CALL    ALPHA               ;1ST CHAR A LETTER?
8890      D0                    RNC                         ;NO-NOT VAR.
8891      23                    INX     H                   ;BUMP PNTR'S
8892      0D                    DCR     C
8893      C2 9F 88              JNZ     MORE                ;MORE TO LINE
8896      C5            SC1:    PUSH    B                   ;SAVE B,EOL
8897      0E 00                 MVI     C,0                 ;SET FOR CALL TO FSYM
8899      2B                    DCX     H                   ;GET SINGLE LETTER
889A      46                    MOV     B,M                 ;VAR TO B
889B      23                    INX     H
889C      C3 D1 88              JMP     SCALR
889F      CD 25 82      MORE:   CALL    ALPHA               ;2ND A LETTER?
88A2      D2 B4 88              JNC     SFSG                ;SO FAR SO GOOD
88A5      C5                    PUSH    B                   ;SAVE C
88A6      3E 02                 MVI     A,2                 ;CHECK FOR DELIMITER
88A8      CD 00 83              CALL    SYMSRT
88AB      C1                    POP     B                   ;RESTORE C
88AC      3C                    INR     A                   ;FOUND?
88AD      C2 96 88              JNZ     SC1                 ;YES
88B0      0C            BUPT:   INR     C                   ;NOT A VAR.
88B1      2B                    DCX     H                   ;BACK UP PNTR'S
88B2      B7                    ORA     A                   ;CY=0 AND RET
88B3      C9                    RET
88B4      CD 17 82      SFSG:   CALL    NUMB                ;TEST FOR NUMBER
88B7      D2 D9 88              JNC     ARCK                ;MAYBE AN ARRAY
```

```
88BA    23                  INX     H           ;ITS A SCALAR
88BB    0D                  DCR     C           ;BUMP PNTR'S
88BC    CA CA 88            JZ      SLOAD       ;EOL
88BF    C5                  PUSH    B           ;SAVE C
88C0    3E 02               MVI     A,2         ;SET UP FOR SYMSRT
88C2    CD 00 83            CALL    SYMSRT      ;TEST FOR LEGAL
88C5    C1                  POP     B           ;GET C BACK
88C6    3C                  INR     A           ;DELIMITER FOUND?
88C7    CA 42 8A            JZ      ER8         ;NO, ERROR
88CA    2B          SLOAD:  DCX     H           ;MOVE BACK,
88CB    C5                  PUSH    B           ;SAVE C,
88CC    4E                  MOV     C,M         ;GET VAR. INTO
88CD    2B                  DCX     H           ;B,C FOR FSYM
88CE    46                  MOV     B,M
88CF    23                  INX     H
88D0    23                  INX     H
88D1    EB          SCALR:  XCHG                ;SAVE H,L IN D,E
88D2    CD 17 86            CALL    FSYM        ;GET PNTR TO VALUE
88D5    EB                  XCHG                ;RESTORE H,L PNTR TO DE
88D6    C1                  POP     B           ;GET C REG BACK
88D7    37                  STC                 ;SET CY,RET
88D8    C9                  RET
88D9    7E          ARCK:   MOV     A,M         ;ARRAY CHEK, GET CHARACTER
88DA    FE A8               CPI     250Q        ;IS IT (?
88DC    CA ED 88            JZ      ARYES       ;YES,ITS AN ARRAY
88DF    3E 02               MVI     A,2         ;NO-CHEK FOR LEGAL DELIM.
88E1    C5                  PUSH    B           ;SAVE C
88E2    CD 00 83            CALL    SYMSRT
88E5    C1                  POP     B           ;RESTORE C
88E6    3C                  INR     A           ;DELIMITER FOUND?
88E7    CA 42 8A            JZ      ER8
88EA    C3 96 88            JMP     SC1         ;1 CHAR. SCALAR VAR.
88ED    2B          ARYES:  DCX     H           ;YES-WE HAVE ARRAY
88EE    7E                  MOV     A,M         ;GET VAR.
88EF    23                  INX     H
88F0    F5                  PUSH    PSW         ;SAVE VAR.
88F1    CD 05 86            CALL    ICP8        ;BUMP PNTR'S
88F4    CD E7 89            CALL    EVAL        ;EVALUATE SUBSCRIPT
88F7    E5                  PUSH    H           ;SAVE REG H,L
88F8    21 7C 04            LXI     H,FREG1
88FB    CD C3 87            CALL    COPDH       ;COPY IT
88FE   EB                    XCHG
88FF   E1                    POP    H          ;RESTORE H,L
8900   CD 35 89              CALL   FIX        ;FIX VALUE
8903   3E A9                 MVI    A,251Q     ;CHECK FOR )
8905   BE                    CMP    M
8906   C2 42 8A              JNZ    ER8
8909   23                    INX    H
890A   0D                    DCR    C          ;BUMP PNTR'S
890B   13                    INX    D          ;PNT TO LOWER 2 BYTES
890C   13                    INX    D
890D   1A                    LDAX   D
890E   47                    MOV    B,A        ;H-BYTE TO B
890F   13                    INX    D          ;PNT TO LOW BYTE
8910   1A                    LDAX   D          ;LOW BYTE TO A
8911   B7                    ORA    A          ;KILL CY
8912   17                    RAL               ;START MULT OF OFFSET
8913   5F                    MOV    E,A        ;BY 4(BYTES/FLTPT =)
8914   78                    MOV    A,B        ;GET H BYTE
8915   17                    RAL
8916   57                    MOV    D,A        ;DE IS OFFSET*2
8917   7B                    MOV    A,E        ;GET LOW
8918   B7                    ORA    A          ;KILL CARRY
8919   17                    RAL
891A   5F                    MOV    E,A
891B   7A                    MOV    A,D
891C   17                    RAL
891D   57                    MOV    D,A
891E   F1                    POP    PSW        ;DE CONTAIN OFFSET*4
891F   C5                    PUSH   B          ;GET VAR., SAVE C
8920   4F                    MOV    C,A
8921   06 00                 MVI    B,0        ;SETUP TO CALL FSYM
8923   E5                    PUSH   H          ;SAVE H,L
8924   CD 17 86              CALL   FSYM       ;GET START ADD.
8927   DA 2F 89              JC     AFOND
892A   3E 12                 MVI    A,12H      ;ERROR 12
892C   C3 C8 85              JMP    ERROR      ;ARRAY REF. NOT DIM'ED.
892F   19           AFOND:   DAD    D          ;H,L NOW PNT TO START OF
8930   EB                    XCHG              ;ARRAY, ADD OFFSET, EXCHG
8931   E1                    POP    H          ;RESTORE PNTR'S AND RET.
8932   C1                    POP    B
8933   37                    STC               ;SET CY
```

```
8934    C9                  RET
                  ;ROUTINE TO FIX FLOATING POINT
                  ;NUMBERS, ALL REG'S BUT A ARE
                  ;MAINTAINED. DE PNT TO 4 BYTES
                  ;OF = TO BE FIXED
8935    C5        FIX:      PUSH    B
8936    E5                  PUSH    H
8937    D5                  PUSH    D               ;SAVE REG'S
8938    13                  INX     D
8939    13                  INX     D
893A    13                  INX     D               ;PNT TO 4TH BYTE
893B    1A                  LDAX    D
893C    F5                  PUSH    PSW             ;SAVE CHAR. (FOR SIGN)
893D    E6 7F               ANI     177Q
893F    17                  RAL                     ;CHEK IF EXP SIGN IS -
8940    17                  RAL
8941    DA 50 89            JC      MINSE
8944    1F                  RAR
8945    1F                  RAR                     ;RESTORE CHAR
8946    FE 18               CPI     30Q             ;IS IT TOO BIG?
8948    DA 52 89            JC      GOOD
894B    3E 13               MVI     A,13H           ;ERROR 13
894D    C3 C8 85            JMP     ERROR           ;FIX = TOO BIG
8950    1F        MINSE:    RAR
8951    1F                  RAR
8952    12        GOOD:     STAX    D               ;ABSOLUTE VALUE
8953    1B                  DCX     D
8954    1B                  DCX     D
8955    1B                  DCX     D               ;MOV PNTR BACK
8956    21 7C 04            LXI     H,FREG1
8959    CD C3 87            CALL    COPDH           ;COPY TO FREG1
895C    21 80 04            LXI     H,FREG2         ;STORE .5*2**24 IN
895F    11 8F 89            LXI     D,FDAT          ;FREG2
8962    CD C3 87            CALL    COPDH           ;COPY IT
8965    21 7C 04            LXI     H,FREG1         ;SET UP TO CALL LADD
8968    06 80               MVI     B,FREG2 AND 377Q
896A    0E 66               MVI     C,SCR AND 377Q
896C    CD D0 97            CALL    LADD            ;ADD THEM,RESULT IN FREG1
896F    21 7C 04            LXI     H,FREG1
8972    F1                  POP     PSW             ;GET SIGN AND ADD.
8973    D1                  POP     D
```

```
8974     17                        RAL
8975     3E 00                     MVI    A,0                  ;GET SIGN ONLY
8977     1F                        RAR
8978     46                        MOV    B,M                  ;GET BYTE1
8979     12                        STAX   D                    ;STORE BYTE 1 OF FIX
897A     78                        MOV    A,B
897B     E6 7F                     ANI    177Q                 ;CLEAR HIGH BIT (FROM ADD)
897D     13                        INX    D
897E     23                        INX    H
897F     46                        MOV    B,M                  ;GET BYTE 2
8980     12                        STAX   D                    ;STORE BYTE 2 OF FIX
8981     13                        INX    D
8982     78                        MOV    A,B
8983     23                        INX    H
8984     46                        MOV    B,M                  ;GET BYTE 3
8985     12                        STAX   D                    ;STORE BYTE 3 OF FIX
8986     78                        MOV    A,B
8987     13                        INX    D
8988     12                        STAX   D                    ;STORE BYTE 4 OF FIX
8989     1B                        DCX    D                    ;FIX D PNTR
898A     1B                        DCX    D
898B     1B                        DCX    D
898C     E1                        POP    H
898D     C1                        POP    B
898E     C9                        RET
898F     80 00 00 18      FDAT:    DB     200Q,0,0,30Q
                          ;INP SAVES ALL REG'S
                          ;SERVES AS BUFFER BETWEEN FINPT AND
                          ;DATA INPUT. IF MODE=0, DATA COMES FROM TTY
                          ;IF MODE=1 DATA COMES FROM SOURCE STMTS.
                          ;IN ALL CASES HL,C ARE UPDATED FROM HLINP, AND
                          ;CREG AND RETURNED TO THOSE LOCATIONS
8993     E5               INP:     PUSH   H                    ;SAVE ALL REG'S
8994     D5                        PUSH   D
8995     C5                        PUSH   B
8996     2A 86 04                  LHLD   HLINP                ;GET PNTR'S
8999     3A 84 04                  LDA    CREG
899C     4F                        MOV    C,A
899D     B7                        ORA    A                    ;CHECK FOR EOL
899E     C2 A7 89                  JNZ    CHKMD                ;NO CHECK MODE
89A1     3E A0            SPACE:   MVI    A,240Q               ;SEND A SPACE
```

```
89A3      C1           IDONE:    POP     B                  ;RESTORE REG'S
89A4      D1                     POP     D
89A5      E1                     POP     H
89A6      C9                     RET                        ;AND RETURN
89A7      3A 85 04     CHKMD:    LDA     MODE               ;GET MODE
89AA      3D                     DCR     A                  ;CHECK IT
89AB      CA B7 89               JZ      MODE1              ;MODE IS 1
89AE      7E                     MOV     A,M                ;MODE 0, GET CHAR.
89AF      FE AC                  CPI     ',' OR 200Q        ;IS IT A ','?
89B1      CA A1 89               JZ      SPACE              ;YES - SEND A SPACE
89B4      C3 DB 89               JMP     BMPTR              ;NO - SEND IT
89B7      CD 17 82     MODE1:    CALL    NUMB               ;NUMBER? (ALSO LOADS IT TO A)
89BA      DA DB 89               JC      BMPTR              ;YES - SEND IT AND BUMP PNTR'S
89BD      FE AE                  CPI     256Q               ;DEC. PNT.?
89BF      CA DB 89               JZ      BMPTR
89C2      FE C5                  CPI     305Q               ;E?
89C4      CA DB 89               JZ      BMPTR
89C7      FE AB                  CPI     253Q               ;+?
89C9      CA D1 89               JZ      CHEKE
89CC      FE AD                  CPI     255Q               ;-?
89CE      C2 A1 89               JNZ     SPACE              ;SEND A SPACE
89D1      47           CHEKE:    MOV     B,A                ;CHEK IF E PRECEDES +,-
89D2      2B                     DCX     H                  ;BACK UP AND GET PRE-
89D3      7E                     MOV     A,M                ;CEDING CHARACTER
89D4      FE C5                  CPI     305Q               ;IS IT E?
89D6      C2 A1 89               JNZ     SPACE              ;NO,+OR- WAS DELIMITTER
89D9      78                     MOV     A,B                ;YES,GET + OR -
89DA      23                     INX     H                  ;RESTORE H,L
89DB      23           BMPTR:    INX     H                  ;BUMP AND STORE PNTR'S
89DC      0D                     DCR     C
89DD      22 86 04               SHLD    HLINP
89E0      21 84 04               LXI     H,CREG
89E3      71                     MOV     M,C
89E4      C3 A3 89               JMP     IDONE              ;RESTORE REG'S AND RETURN
                       ;THIS ROUTINE WILL EVALUATE UNARY AND/OR
                       ;BINARY EXPRESIONS CALLED WITH H AND L
                       ;POINTING TO FIRST CHAR. OF EXP.,C CONTAINS
                       ;NUMBER OF CHAR'S LEFT IN LINE. RETURNS
                       ;D(H) AND E(L) POINTING TO THE ANSWER
                       ;THIS ROUTINE CALLS ITSELF RECURSIVELY
                       ;IN ORDER TO EVALUATE SUBSCRIPT
```

```
                        ;EXPRESIONS.  REG A,B DESTROYED
                        ;C,H,L ARE UPDATED
89E7    3E AD           EVAL:   MVI     A,255Q          ;IS IT UNARY -
89E9    BE                      CMP     M               ;Z=1 => YES
89EA    F5                      PUSH    PSW             ;Z=0 => NO
89EB    C2 F1 89                JNZ     ECAV
89EE    CD 05 86                CALL    ICP8            ;BUMP POINTER
89F1    CD DE 87        ECAV:   CALL    VALUE           ;GET PNTR. TO VALUE
89F4    E5                      PUSH    H               ;GET VALUE TO FREG1
89F5    21 7C 04                LXI     H,FREG1
89F8    CD C3 87                CALL    COPDH
89FB    EB                      XCHG
89FC    E1                      POP     H
89FD    F1                      POP     PSW             ;GET SIGN
89FE    C2 0C 8A                JNZ     DOL             ;SHALL WE NEGATE?
8A01    13                      INX     D               ;YES, POINT TO CHAR.
8A02    13                      INX     D
8A03    13                      INX     D
8A04    1A                      LDAX    D               ;AND LOAD TO A
8A05    17                      RAL                     ;ROTATE SIGN TO CY
8A06    3F                      CMC                     ;COMPLEMENT IT
8A07    1F                      RAR                     ;ROTATE BACK
8A08    12                      STAX    D               ;STORE AWAY
8A09    1B                      DCX     D               ;AND FIX PNTR.
8A0A    1B                      DCX     D
8A0B    1B                      DCX     D
8A0C    79              DOL:    MOV     A,C             ;IS THIS END OF LINE?
8A0D    B7                      ORA     A
8A0E    C8                      RZ                      ;YES-RETURN
8A0F    C5                      PUSH    B               ;SAVE C
8A10    3E 02                   MVI     A,2             ;NO SET UP TO CALL
8A12    CD 00 83                CALL    SYMSRT          ;SYMSRT AND CALL
8A15    C1                      POP     B               ;RESTORE C
8A16    3C                      INR     A               ;DELIMITER FOUND?
8A17    CA 42 8A                JZ      ER8             ;NO, ERROR
8A1A    D6 0A           EOK:    SUI     10              ;CHECK FOR EXPRESSION
8A1C    D8                      RC                      ;DELIMITER
8A1D    F5                      PUSH    PSW             ;SAVE OVERATION
8A1E    CD 05 86                CALL    ICP8            ;BUMP PNTR'S
8A21    B7                      ORA     A               ;CLEAR CY
8A22    E5              AGA:    PUSH    H               ;GET BYTES OF NUMBER
```

```
8A23   1A                  LDAX    D           ;AND PLACE ON STACK
8A24   6F                  MOV     L,A
8A25   13                  INX     D
8A26   1A                  LDAX    D
8A27   13                  INX     D
8A28   67                  MOV     H,A         ;2 BYTES TO H,L
8A29   E3                  XTHL                ;XCHANGE, RESTORES H,L
8A2A   3F                  CMC
8A2B   DA 22 8A            JC      AGA         ;ANOTHER PASS?
8A2E   CD DE 87            CALL    VALUE       ;GET 2ND VALUE
8A31   79                  MOV     A,C         ;CHECK FOR END OF LINE
8A32   B7                  ORA     A           ;IF SO => WELL FORMED
8A33   CA 47 8A            JZ      WFOR
8A36   C5                  PUSH    B           ;SAVE C
8A37   3E 02               MVI     A,2         ;ELSE CALL SYMSRT TO
8A39   CD 00 83            CALL    SYMSRT      ;CHEK FOR EXP. DEL.
8A3C   C1                  POP     B           ;RECOVER IT
8A3D   FE 0A               CPI     10
8A3F   DA 47 8A            JC      WFOR        ;YES, WELL FORMED
8A42   3E 08       ER8:    MVI     A,8         ;ILL-FORMED EXP.
8A44   C3 C8 85            JMP     ERROR
8A47   C5          WFOR:   PUSH    B           ;SAVE C, AND H,L
8A48   E5                  PUSH    H
8A49   21 80 04            LXI     H,FREG2     ;COPY 2ND VALUE TO
8A4C   CD C3 87            CALL    COPDH       ;FREG2
8A4F   D1                  POP     D           ;GET BYTES FROM STACK
8A50   C1                  POP     B
8A51   E1                  POP     H           ;INTO FREG1+2
8A52   22 7E 04            SHLD    FREG1+2
8A55   E1                  POP     H           ;AND NEXT 2 BYTES
8A56   22 7C 04            SHLD    FREG1       ;FROM STACK TO FREG1
8A59   EB                  XCHG
8A5A   F1                  POP     PSW         ;GET OPERATION
                   ;THIS ROUTINE PERFORMS BINARY OPERATIONS ON OPERANDS IN FREG1 AND
                   ;FREG2 B,C,H,L ARE LEFT UNDISTURBED. A IS DESTROYED
                   ;D,E PNT TO RESULT
                   ;OPERATIONS ARE SPECIFIED BY A REGISTER AS FOLLOWS:
                   ;
                   ;       A=0     =>          FREG1 * FREG2
                   ;       A=1     =>          FREG1 / FREG2
                   ;       A=2     =>          FREG1 + FREG2
```

```
                          ;          A=3     =>                FREG1 - FREG2
                          ;
                          ;IN CASE OF ARITHMETIC ERROR A MESSAGE IS SENT TO USER.
                          ;IF A CONTAINS ILLEGAL OPERATION REQUEST ERROR IS SENT TO USER
                          ;(ERROR 8) AND THE INTERPRETER IS ABORTED.
8A5B     C5               BINOP:     PUSH    B                     ;SAVE REG'S
8A5C     E5                          PUSH    H
8A5D     21 7C 04                    LXI     H,FREG1               ;SET UP PNTR'S TO
8A60     06 80                       MVI     B,FREG2 AND 377Q      ;FREG'S AND SCR AREA
8A62     0E 66                       MVI     C,SCR AND 377Q        ;AND DO OPERATION
8A64     3D                          DCR     A
8A65     FA A7 8A                    JM      FMULT                 ;0,1=>* OR /
8A68     CA AD 8A                    JZ      DIV                   ;2,3=>+ OR -
8A6B     3D                          DCR     A
8A6C     CA 76 8A                    JZ      ADDD
8A6F     3D                          DCR     A
8A70     CA A1 8A                    JZ      SUBB
8A73     C3 42 8A                    JMP     ER8                   ;ILLEGAL OPER.
8A76     CD D0 97         ADDD:      CALL    LADD                  ;DO ADDITION
8A79     54               ASBC:      MOV     D,H                   ;FIX PNTR'S FOR RET.
8A7A     5D                          MOV     E,L
8A7B     B7               FPERR:     ORA     A                     ;SET FLAGS
8A7C     CA 9E 8A                    JZ      NFPER                 ;NO ERROR
8A7F     D5                          PUSH    D                     ;SAVE DE
8A80     F5                          PUSH    PSW                   ;SAVE A
8A81     CD D3 82                    CALL    WRIT                  ;DUMP BUFFER
8A84     F1                          POP     PSW                   ;GET A BACK
8A85     21 97 8A                    LXI     H,WFPER               ;RETURN ADDRESS
8A88     E5                          PUSH    H                     ;SAVE ON STACK
8A89     21 69 84                    LXI     H,ODATA               ;MESSAGE TABLE
8A8C     17                          RAL                           ;UNDERFLOW?
8A8D     DA 4E 84                    JC      FOR12                 ;YES
8A90     17                          RAL                           ;OVERFLOW?
8A91     DA 4F 84                    JC      FOR11                 ;YES
8A94     C3 50 84                    JMP     FOR10                 ;NO - ITS ZERODIVIDE
8A97     21 69 84         WFPER:     LXI     H,ODATA               ;MESSAGE TABLE
8A9A     CD E9 85                    CALL    ERLN                  ;PRINT 'IN LINE --' (USE PART OF
8A9D     D1                          POP     D                     ;ERROR RESTORE REG'S
8A9E     E1               NFPER:     POP     H
8A9F     C1                          POP     B
8AA0     C9                          RET
```

```
8AA1    CD D9 97    SUBB:     CALL    LSUB          ;DO SUBTRACTION
8AA4    C3 79 8A              JMP     ASBC
8AA7    CD D3 97    FMULT:    CALL    LMUL          ;DO MULT.
8AAA    C3 B0 8A              JMP     MDBC
8AAD    CD D6 97    DIV:      CALL    LDIV          ;DO DIV.
8AB0    54          MDBC:     MOV     D,H           ;AND FIX PNTR'S FOR RET.
8AB1    59                    MOV     E,C .
8AB2    C3 7B 8A              JMP     FPERR         ;CHECK FOR ERROR
                    ;PRINT PROCESSOR
8AB5    2A 5B 04    PRI:      LHLD    CPNT
8AB8    23                    INX     H             ;INCR. PAST KEYWORD
8AB9    23                    INX     H
8ABA    23                    INX     H
8ABB    CD 00 86              CALL    ICP7
8ABE    23                    INX     H             ;BUMP PNTRS
8ABF    0D                    DCR     C
8AC0    06 00                 MVI     B,0           ;SET CHAR CNT
8AC2    C2 CE 8A              JNZ     PLOOP         ;CONTINUE IF MORE
8AC5    04                    INR     B             ;NOTHING MORE, PAD A NULL
8AC6    3E 00                 MVI     A,0
8AC8    CD B0 82              CALL    PAD
8ACB    C3 66 8B              JMP     PEND          ;WRITE IT AND CONTINUE
8ACE    7E          PLOOP:    MOV     A,M           ;GET CHARACTER
8ACF    FE A2                 CPI     '"'+200Q      ;IS IT "?
8AD1    C2 F6 8A              JNZ     EXPRE         ;NO
8AD4    CD 00 86    QUOTE:    CALL    ICP7          ;GET CHARACTER TO A
8AD7    7E                    MOV     A,M
8AD8    FE A2                 CPI     '"'+200Q      ;IS IT "?
8ADA    CA E8 8A              JZ      QCHEK
8ADD    04          QOTOK:    INR     B             ;INCREMENT CNT
8ADE    50                    MOV     D,B           ;SAVE IN D
8ADF    06 01                 MVI     B,1           ;PAD ONCE
8AE1    CD B0 82              CALL    PAD
8AE4    42                    MOV     B,D           ;RESTORE CNT
8AE5    C3 D4 8A              JMP     QUOTE         ;AGAIN
8AE8    23          QCHEK:    INX     H             ;BUMP PNTRS
8AE9    0D                    DCR     C
8AEA    CA 66 8B              JZ      PEND          ;EOL
8AED    7E                    MOV     A,M
8AEE    FE A2                 CPI     '"'+200Q      ;ANOTHER "?
8AF0    CA DD 8A              JZ      QOTOK
```

```
8AF3    C3 27 8B              JMP    SCOLN
8AF6    CD 25 82    EXPRE:    CALL   ALPHA               ;IS IT A LETTER
8AF9    DA 0D 8B              JC     PRTIT               ;YES, EVALUATE AND PRINT
8AFC    CD 17 82              CALL   NUMB                ;IS IT A NUMB?
8AFF    DA 0D 8B              JC     PRTIT               ;YES, EVALUATE AND PRINT
8B02    7E                    MOV    A,M
8B03    FE AE                 CPI    '.'+200Q            ;IS IT A DECIMAL PNT?
8B05    CA 0D 8B              JZ     PRTIT               ;YES EVALUATE, PRINT
8B08    FE AD                 CPI    '-'+200Q            ;IS IT A -?
8B0A    C2 27 8B              JNZ    SCOLN               ;NO, CHECK FOR ;
8B0D    C5          PRTIT:    PUSH   B                   ;SAVE CNT
8B0E    CD E7 89              CALL   EVAL                ;EVALUATE EXPRESION
8B11    C5                    PUSH   B                   ;SAVE C,H,L
8B12    E5                    PUSH   H
8B13    EB                    XCHG                       ;DE TO HL
8B14    0E 66                 MVI    C,SCR AND 377Q      ;SET UP, CONVERT
8B16    CD E5 97              CALL   CONV
8B19    E1                    POP    H                   ;RESTORE REG'S
8B1A    C1                    POP    B
8B1B    79                    MOV    A,C
8B1C    C1                    POP    B
8B1D    4F                    MOV    C,A
8B1E    B7                    ORA    A                   ;CHECK EOL
8B1F    CA 66 8B              JZ     PEND
8B22    3E 0B                 MVI    A,11                ;UPDATE CNTR
8B24    80                    ADD    B
8B25    47                    MOV    B,A
8B26    7E                    MOV    A,M                 ;GET CHAR.
8B27    FE BB       SCOLN:    CPI    ';'+200Q            ;IS IT ;?
8B29    CA 59 8B              JZ     SONWD               ;YES
8B2C    FE AC                 CPI    ','+200Q            ;IS IT ,?
8B2E    C2 44 87              JNZ    ER6                 ;NO-UNEXPECTED CHAR.
8B31    AF                    XRA    A                   ;ZERO A
8B32    C6 0D       ADFLD:    ADI    13                  ;ADD FIELD LENGTH
8B34    B8                    CMP    B                   ;COMPARE TO CNT
8B35    CA 3B 8B              JZ     $+6
8B38    D2 4D 8B              JNC    FLDFD
8B3B    FE 34                 CPI    52                  ;LAST FLD?
8B3D    C2 32 8B              JNZ    ADFLD
8B40    CD D3 82              CALL   WRIT                ;YES-WRITE LINE
8B43    06 00                 MVI    B,0                 ;RESET CNT
```

```
8B45   23          ONWD:   INX    H          ;BUMP PNTRS
8B46   0D                  DCR    C
8B47   CA 66 8B            JZ     PEND
8B4A   C3 CE 8A            JMP    PLOOP
8B4D   90          FLDFD:  SUB    B          ;FOUND FIELD
8B4E   50                  MOV    D,B        ;DETERMIN  OF SPACES TO PAD
8B4F   5F                  MOV    E,A        ;SET UP TO CALL PAD
8B50   47                  MOV    B,A
8B51   3E A0               MVI    A,240Q
8B53   CD B0 82            CALL   PAD        ;PAD SPACES
8B56   7A                  MOV    A,D
8B57   83                  ADD    E          ;NEW CNT
8B58   47                  MOV    B,A        ;SAVE IN B
8B59   23          SONWD:  INX    H          ;CHECK EOL
8B5A   0D                  DCR    C
8B5B   C2 CE 8A            JNZ    PLOOP
8B5E   16 01               MVI    D,1        ;SUPPRESS CR/LF
8B60   CD D5 82            CALL   WRIT1
8B63   C3 69 8B            JMP    $+6
8B66   CD D3 82    PEND:   CALL   WRIT       ;DUMP BUFFER, CONTINUE
8B69   C3 AC 8B            JMP    IEND
                   ;INPUT PROCESSOR - READS VALUES FROM TTY
                   ;THEY MUST BE DELIMITED BY COMMAS ONLY
8B6C   79          INPUT:  MOV    A,C        ;IN CASE OF ERROR
8B6D   32 5F 04            STA    PL6        ;SAVE
8B70   2A 5B 04    INPER:  LHLD   CPNT       ;INPUT LINE (V-STRING) PNTR
8B73   23                  INX    H          ;ADJUST PNTR'S
8B74   23                  INX    H
8B75   23                  INX    H
8B76   CD 00 86            CALL   ICP7
8B79   CD 00 86            CALL   ICP7
8B7C   C5          PRMPT:  PUSH   B          ;SAVE PNTR'S
8B7D   E5                  PUSH   H
8B7E   06 01               MVI    B,1        ;SEND PROMPT
8B80   3E 3A               MVI    A,':'
8B82   50                  MOV    D,B        ;TO SUPPRESS CR/LF
8B83   CD B0 82            CALL   PAD        ;PAD IT
8B86   CD D5 82            CALL   WRIT1      ;WRITE IT
8B89   21 01 04            LXI    H,IBUF     ;ADD. OF INPUT BUFFER
8B8C   CD D2 83            CALL   TTYIN      ;READ A LINE
8B8F   EB                  XCHG              ;ADD. OF K-STRING TO DE
```

```
8B90     E1                 POP     H                  ;ADD. OF V-STRING
8B91     C1                 POP     B                  ;V-STRING CNT TO C
8B92     47                 MOV     B,A                ;K-STRING CNT TO B
8B93     CD B2 8B           CALL    STRIN              ;TRANSFER CONSTANTS TO VARIBLES
8B96     CA A9 8B           JZ      INPOK              ;NO ERROR
8B99     21 69 84           LXI     H,ODATA            ;SEND ERROR MESSAGE
8B9C     CD 51 84           CALL    FORM9
8B9F     CD D3 82           CALL    WRIT
8BA2     3A 5F 04           LDA     PL6                ;GET V-STRING CNT
8BA5     4F                 MOV     C,A
8BA6     C3 70 8B           JMP     INPER              ;START AGAIN
8BA9     DA 7C 8B   INPOK:  JC      PRMPT              ;NEED MORE CONSTANTS
8BAC     2A 56 04   IEND:   LHLD    KFPNT              ;ALL OK - GET NEW PNTR.
8BAF     C3 A4 86           JMP     ILOOP              ;CONTINUE
                    ;THIS ROUTINE TRANSFERS THE FLOATING POINT VALUES
                    ;OF AN ASCII STRING OF CONSTANTS TO THE LOCATIONS
                    ;SPECIFIED BY AN ASCII STRING OF VARIBLES
                    ;POINTER AND LINE CNT OF VAR. STRING ARE IN HL,C
                    ;POINTER AND LINE CNT OF CONST. STRING ARE IN DE,B
                    ;ON RETURN:
                    ;       Z=0 AND CY=0   ALL OK
                    ;       Z=0 AND CY=1   NEED MORE CONSTANTS
                    ;       Z=1            ERROR IN CONVERSION
                    ;ALL POINTERS AND LINE CNT'S ARE RETURNED UPDATED
8BB2     79         STRIN:  MOV     A,C                ;GET V-STRING CNT
8BB3     B7                 ORA     A                  ;TEST FOR EOL
8BB4     C8                 RZ                         ;DONE, CY=0 => ALL OK
8BB5     7E                 MOV     A,M                ;GET CHAR.
8BB6     FE AC              CPI     ',' OR 200Q        ;IS IT A ,?
8BB8     C2 C0 8B           JNZ     STOKV              ;IT'S NOT A ,
8BBB     23                 INX     H                  ;COMMA, BUMP PNTR'S
8BBC     0D                 DCR     C
8BBD     CA E8 8B           JZ      ERRET              ;POSSIBLE ERROR (IF EOL)
8BC0     78         STOKV:  MOV     A,B                ;GET K-STRING LENGTH
8BC1     B7                 ORA     A                  ;TEST FOR EOL
8BC2     37                 STC                        ;IN CASE IT'S EOL
8BC3     C8                 RZ                         ;RET, CY=1 =@ NEED MORE CONSTANTS
8BC4     1A                 LDAX    D                  ;GET CHAR
8BC5     FE AC              CPI     ',' OR 200Q        ;TEST FOR ,
8BC7     C2 CF 8B           JNZ     STOKK              ;NOT A , - READY TO GO
8BCA     13                 INX     D                  ;BUMP PNTR'S
```

```
8BCB    05                  DCR    B           ;POSSIBLE ERROR (IF EOL)
8BCC    CA E8 8B            JZ     ERRET       ;SAVE K-STRING CNT
8BCF    C5         STOKK:   PUSH   B           ;SAVE K-STRING PNTR
8BD0    D5                  PUSH   D           ;ADD. TO VARIBLE TO DE
8BD1    CD 8D 88            CALL   VAR         ;VAR. ADD TO H,L
8BD4    EB                  XCHG               ;SAVE
8BD5    22 8A 04            SHLD   VARAD       ;ADDRESS OF K-STRING
8BD8    E1                  POP    H           ;V-STRING CNT TO A
8BD9    79                  MOV    A,C         ;K-STRING CNT TO B
8BDA    C1                  POP    B           ;K-STRING CNT TO C
8BDB    48                  MOV    C,B         ;SAVE V-STRING CNT
8BDC    F5                  PUSH   PSW         ;SAVE V-STRING ADD.
8BDD    D5                  PUSH   D           ;A=0 =@ DATA FROM TTY
8BDE    3E 00               MVI    A,0         ;GET CONSTANT TO GREG
8BE0    CD 6E 88            CALL   RDKON
8BE3    D2 EB 8B            JNC    STNER       ;EMPTY STACK
8BE6    E1                  POP    H
8BE7    E1                  POP    H           ;ERROR
8BE8    AF         ERRET:   XRA    A
8BE9    3C                  INR    A
8BEA    C9                  RET                ;SAVE K-STRING PNTR.
8BEB    E5         STNER:   PUSH   H           ;GET VAR. ADD
8BEC    2A 8A 04            LHLD   VARAD       ;ADD. TO CONST.
8BEF    11 77 04            LXI    D,GREG      ;COPY IT TO VARIABLE LOC.
8BF2    CD C3 87            CALL   COPDH       ;K-STING PNTR. TO DE
8BF5    D1                  POP    D           ;K-STRING LENGTH TO B
8BF6    41                  MOV    B,C         ;V-STRING PNTR. TO HL
8BF7    E1                  POP    H           ;V-STRING LENGTH TO C
8BF8    F1                  POP    PSW
8BF9    4F                  MOV    C,A         ;LOOP
8BFA    C3 B2 8B            JMP    STRIN
                   ;LET STMT. PROCESSOR        ;GET PNTR.
8BFD    2A 5B 04   LET:     LHLD   CPNT        ;FIX PNTR.
8C00    23                  INX    H
8C01    23                  INX    H
8C02    23                  INX    H           ;CHECK FOR EOL
8C03    79                  MOV    A,C
8C04    B7                  ORA    A
8C05    C2 0D 8C            JNZ    LOK
8C08    3E 07      ER7:     MVI    A,7
8C0A    C3 C8 85            JMP    ERROR
```

```
8C0D    CD 8D 88    LOK:    CALL    VAR         ;GET ADDRESS TO VAR.
8C10    DA 52 8C            JC      SAVV        ;IT'S A VARIABLE
8C13    3E 03               MVI     A,3         ;NO-CHEK FOR FUNC.
8C15    CD 00 83            CALL    SYMSRT
8C18    FE FF               CPI     377Q
8C1A    CA 42 8A            JZ      ER8         ;DON'T KNOW WHAT IT IS
8C1D    3D                  DCR     A
8C1E    C2 98 8C            JNZ     ER10        ;ILLEGAL USE OF FUNC.
8C21    23                  INX     H           ;IT'S PUT,UPDATE H,L
8C22    23                  INX     H
8C23    23                  INX     H
8C24    79                  MOV     A,C         ;EOL CHK
8C25    B7                  ORA     A
8C26    CA 42 8A            JZ      ER8
8C29    7E                  MOV     A,M         ;CHEK FOR (
8C2A    FE A8               CPI     250Q
8C2C    C2 42 8A            JNZ     ER8
8C2F    CD 05 86            CALL    ICP8        ;BUMP PNTRS
8C32    CD E7 89            CALL    EVAL        ;EVALUATE AND FIX
8C35    E5                  PUSH    H           ;SAVE H,L
8C36    21 7C 04            LXI     H,FREG1
8C39    CD C3 87            CALL    COPDH       ;COPY IT
8C3C    EB                  XCHG
8C3D    E1                  POP     H
8C3E    CD 35 89            CALL    FIX
8C41    13                  INX     D
8C42    13                  INX     D
8C43    13                  INX     D
8C44    1A                  LDAX    D           ;GET LOWEST BYTE
8C45    F5                  PUSH    PSW         ;PORT = IS SAVED
8C46    7E                  MOV     A,M
8C47    FE A9               CPI     251Q        ;CHECK FOR )
8C49    C2 42 8A            JNZ     ER8
8C4C    CD 05 86            CALL    ICP8        ;BUMP PNTR'S
8C4F    16 FF               MVI     D,377Q
8C51    5A                  MOV     E,D
8C52    D5          SAVV:   PUSH    D           ;KEEP ADDRESS
8C53    7E                  MOV     A,M         ;CHEK FOR =
8C54    FE BD               CPI     275Q
8C56    C2 42 8A            JNZ     ER8
8C59    CD 05 86            CALL    ICP8        ;BUMP PNTRS
```

```
8C5C     CD E7 89                CALL   EVAL          ;EVALUATE EXPRESSION
8C5F     E1                      POP    H             ;GET ADDRESS
8C60     CD A6 82                CALL   CHK1
8C63     DA 6C 8C                JC     PTFIN         ;IT WAS A PUT
8C66     CD C3 87                CALL   COPDH         ;COPY TO ADDRESS
8C69     C3 AC 8B                JMP    IEND          ;CONTINUE
8C6C     21 7C 04       PTFIN:   LXI    H,FREG1       ;COPY VALUE TO FREG1
8C6F     CD C3 87                CALL   COPDH
8C72     EB                      XCHG
8C73     CD 35 89                CALL   FIX           ;FIX THE VALUE
8C76     13                      INX    D
8C77     13                      INX    D
8C78     13                      INX    D
8C79     1A                      LDAX   D
8C7A     4F                      MOV    C,A           ;SAVE IN C
8C7B     21 93 8C                LXI    H,PINST       ;ADD OF BYTES TO GO TO
8C7E     11 77 04                LXI    D,GREG        ;RAM AT GREG
8C81     06 05                   MVI    B,5           ;BYTE CNT
8C83     7E             PRI1:    MOV    A,M           ;STORE PROG. SEG. IN
8C84     12                      STAX   D             ;RAM
8C85     23                      INX    H
8C86     13                      INX    D
8C87     05                      DCR    B
8C88     C2 83 8C                JNZ    PRI1
8C8B     F1                      POP    PSW           ;GET PORT =
8C8C     21 78 04                LXI    H,GREG+1
8C8F     77                      MOV    M,A           ;STORE
8C90     79                      MOV    A,C           ;GET DATA OUT TO A
8C91     2B                      DCX    H             ;TRANSFER
8C92     E9                      PCHL
8C93     D3 00          PINST:   OUT    0             ;RAM INSTRUCTIONS
8C95     C3 AC 8B                JMP    IEND
8C98     3E 10          ER10:    MVI    A,10H
8C9A     C3 C8 85                JMP    ERROR
                        ;IF STMT. PROCESSOR
8C9D     2A 5B 04       IFRT:    LHLD   CPNT          ;GET PNTR., ADJUST
8CA0     23                      INX    H
8CA1     0C                      INR    C             ;CHECK EOL
8CA2     CD 00 86                CALL   ICP7
8CA5     CD E7 89                CALL   EVAL          ;EVALUATE EXPRESSION
8CA8     79                      MOV    A,C
```

```
8CA9    B7                  ORA     A           ;CHECK EOL
8CAA    CA 08 8C            JZ      ER7
8CAD    E5          IAGA:   PUSH    H           ;SAVE H,L, PUT VALUE ON STK
8CAE    1A                  LDAX    D
8CAF    13                  INX     D
8CB0    6F                  MOV     L,A
8CB1    1A                  LDAX    D
8CB2    13                  INX     D
8CB3    67                  MOV     H,A
8CB4    E3                  XTHL                ;RESTORE H,L
8CB5    3F                  CMC
8CB6    DA AD 8C            JC      IAGA        ;ANOTHER PASS?
8CB9    3E 02               MVI     A,2
8CBB    CD 00 83            CALL    SYMSRT      ;CHEK TYPE OF RELATION
8CBE    FE 04               CPI     4           ;WAS IT LEGAL?
8CC0    DA C8 8C            JC      II1
8CC3    3E 14       ER14:   MVI     A,14H
8CC5    C3 C8 85            JMP     ERROR
8CC8    FE 02       II1:    CPI     2           ;WAS IT A ,?
8CCA    CA C3 8C            JZ      ER14
8CCD    3C                  INR     A           ;ALL OK, INC,SAVE
8CCE    F5                  PUSH    PSW
8CCF    0C                  INR     C
8CD0    CD 00 86            CALL    ICP7        ;BUMP PNTRS
8CD3    3E 02               MVI     A,2         ;CALL SYMSRT
8CD5    CD 00 83            CALL    SYMSRT
8CD8    FE FF               CPI     377Q        ;FOUND ANYTHING?
8CDA    CA F5 8C            JZ      RELAT       ;DONE
8CDD    FE 02               CPI     2
8CDF    CA C3 8C            JZ      ER14        ;IT WAS A ,
8CE2    FE 04               CPI     4
8CE4    D2 C3 8C            JNC     ER14        ;NOT LEGAL
8CE7    3C                  INR     A
8CE8    47                  MOV     B,A
8CE9    0C                  INR     C
8CEA    CD 00 86            CALL    ICP7
8CED    F1                  POP     PSW         ;GET SECOND RELATION
8CEE    80                  ADD     B           ;ADD THEM
8CEF    F5                  PUSH    PSW         ;AND SAVE
8CF0    FE 08               CPI     10Q         ;TEST FOR ==
8CF2    CA C3 8C            JZ      ER14
```

```
                              ;RELATION IS STORED ON TOP OF STACK (PUSH PSW) ACCORDING TO
                              ;THE FOLLOWING
                              ;
                              ;         1 =>    <
                              ;         2 =>    >
                              ;         3 =>    <>
                              ;         4 =>    =
                              ;         5 =>    <=
                              ;         6 =>    >=
                              ;
8CF5     CD E7 89             RELAT:    CALL    EVAL             ;EVALUATE
8CF8     E5                             PUSH    H                ;SAVE H,L
8CF9     21 80 04                       LXI     H,FREG2          ;COPY TO FREG2
8CFC     CD C3 87                       CALL    COPDH
8CFF     E1                             POP     H                ;GET H,L
8D00     F1                             POP     PSW              ;AND RELATION
8D01     E3                             XTHL                     ;GET 2ND 2 BYTES
8D02     22 7E 04                       SHLD    FREG1+2          ;STORE
8D05     E1                             POP     H                ;GET 1ST 2 BYTES,STORE
8D06     E3                             XTHL
8D07     22 7C 04                       SHLD    FREG1
8D0A     C5                             PUSH    B
8D0B     F5                             PUSH    PSW              ;SAVE A,B,C
8D0C     CD 43 8D                       CALL    FCOMP            ;COMPARE NUMBERS
8D0F     57                             MOV     D,A              ;SAVE RESULT IN D
8D10     F1                             POP     PSW              ;GET RELATION,B,C
8D11     C1                             POP     B
8D12     BA                             CMP     D                ;SAME?
8D13     CA 36 8D                       JZ      TRUE             ;YES
8D16     D6 04                          SUI     4
8D18     F2 28 8D                       JP      NOT3             ;NOT RELATION 3
8D1B     3C                             INR     A                ;IS IT RELATION 3?
8D1C     C2 32 8D                       JNZ     FALSE            ;NO, ITS FALSE
8D1F     3E 04                          MVI     A,4              ;IT IS, CHECK FOR INEQUALITY
8D21     BA                             CMP     D
8D22     C2 36 8D                       JNZ     TRUE
8D25     C3 32 8D                       JMP     FALSE
8D28     BA                   NOT3:     CMP     D                ;RELATION 5,6 TRUE?
8D29     CA 36 8D                       JZ      TRUE             ;YES
8D2C     3E 04                          MVI     A,4              ;IT WAS, CHECK FOR EQUALITY
8D2E     BA                             CMP     D
```

```
8D2F      CA 36 8D               JZ     TRUE
8D32      E1            FALSE:   POP    H               ;CONTINUE
8D33      C3 AC 8B               JMP    IEND
8D36      E1            TRUE:    POP    H
8D37      06 04                  MVI    B,4
8D39      CD 00 86      THEN:    CALL   ICP7            ;INCREMENT PAST THEN
8D3C      05                     DCR    B
8D3D      C2 39 8D               JNZ    THEN
8D40      C3 21 87               JMP    GTRA            ;TRANSFER TO GOTO
                        ;ROUTINE FCOMP COMPARES 2 FLOATING POINT ='S.  THEY ARE ASSUMED
                        ;TO BE IN FREG1 AND FREG2.
                        ;ALL REGISTERS ARE DESTROYED.
                        ;THE VALUE RETURNED IN REG A IS RESULT OF COMPARISON.
                        ;RESULTS ARE AS FOLLOWS:
                        ;
                        ;        A=1    =>     FREG1 < FREG2
                        ;        A=2    =>     FREG1 > FREG2
                        ;        A=4    =>     FREG1 = FREG2
                        ;
8D43      21 7F 04      FCOMP:   LXI    H,FREG1+3       ;PNTS TO CHAR OF 1ST
8D46      11 83 04               LXI    D,FREG2+3       ;PNTS TO CHAR OF 2ND
8D49      7E                     MOV    A,M             ;GET  1 CHAR
8D4A      06 80                  MVI    B,200Q          ;MASK TO B
8D4C      A0                     ANA    B               ;GET SIGN,  1
8D4D      4F                     MOV    C,A             ;SAVE IN C
8D4E      1A                     LDAX   D               ;GET CHAR  2
8D4F      A0                     ANA    B               ;GET SIGN  2
8D50      A9                     XRA    C
8D51      CA 5B 8D               JZ     SINEQ           ;SAME SIGNS
8D54      79                     MOV    A,C             ;OPPISITE SIGNS,GET  1 SIGN
8D55      17                     RAL                    ;ROTATE TO CY
8D56      3E 01                  MVI    A,1
8D58      D8                     RC                     ;FREG1 < FREG2 => A=1
8D59      3C                     INR    A               ;ELSE FREG1 > FREG2
8D5A      C9                     RET                    ;AND A=2
8D5B      C5            SINEQ:   PUSH   B               ;SAVE SIGN
8D5C      2B                     DCX    H               ;PNTR TO  1 IN H,L
8D5D      2B                     DCX    H
8D5E      2B                     DCX    H
8D5F      43                     MOV    B,E             ;PNTR TO  2 IN B
8D60      05                     DCR    B
```

```
8D61    05                  DCR     B
8D62    05                  DCR     B
8D63    CD DF 97            CALL    LMCM            ;COMPARE MAGNITUDES
                ;AT THIS POINT Z=1 => =,  CY=1 => 1<2
8D66    C1                  POP     B               ;GET SIGN BACK
8D67    C2 6D 8D            JNZ     $+6
8D6A    3E 04               MVI     A,4             ;EQUAL => A=4
8D6C    C9                  RET
8D6D    79                  MOV     A,C             ;GET SIGN TO A
8D6E    3C                  INR     A               ;SET SIGN BIT
8D6F    3E 01               MVI     A,1
8D71    FA 77 8D            JM      $+6.            ;SIGN IS NEGATIVE
8D74    D8                  RC                      ;SIGN=+ AND ABS(FREG1)<ABS(FREG2)
8D75    3C                  INR     A               ;ABS(FREG1)>ABS(FREG2)
8D76    C9                  RET
8D77    D0                  RNC                     ;SIGN=- AND ABS(FREG1)>ABS(FREG2)
8D78    3C                  INR     A               ;ABS(FREG1)<ABS(FREG2)
8D79    C9                  RET
                ;CALL PROCESSOR
8D7A    21 AC 8B    CALLP:  LXI     H,IEND          ;INIT RETURN ADDRESS
8D7D    E5                  PUSH    H
8D7E    2A 5B 04            LHLD    CPNT            ;INIT POINTERS
8D81    23                  INX     H
8D82    23                  INX     H
8D83    23                  INX     H
8D84    CD 00 86            CALL    ICP7
8D87    7E                  MOV     A,M             ;GET CHAR
8D88    FE A8               CPI     '('+200Q        ;IS IT A (?
8D8A    C2 08 8C            JNZ     ER7             ;BAD
8D8D    CD 00 86            CALL    ICP7            ;BUMP PNTRS
8D90    CD 2D 82            CALL    CVB             ;GET SUB
8D93    85                  ADD     L               ;UPDATA H,L
8D94    6F                  MOV     L,A
8D95    3E 00               MVI     A,0
8D97    8C                  ADC     H
8D98    67                  MOV     H,A             ;D NOW CONTAINS SUB
8D99    E5                  PUSH    H               ;SAVE HL
8D9A    2A 02 01            LHLD    SUBAD          ;GET START OF SUB TABLE
8D9D    7E          NUSUB:  MOV     A,M             ;GET ENTRY
8D9E    BA                  CMP     D               ;COMPARE
8D9F    CA AE 8D            JZ      FNDSB           ;FOUND IT
8DA2    23                      INX     H           ;PNT TO NEXT ENTRY
8DA3    23                      INX     H
8DA4    23                      INX     H
8DA5    3C                      INR     A           ;CHECK TO SEE IF LAST WAS 377Q
8DA6    C2 9D 8D                JNZ     NUSUB
8DA9    3E 15                   MVI     A,15H       ;ER 15 - NO SUB BY THIS =
8DAB    C3 C8 85                JMP     ERROR
8DAE    23              FNDSB:  INX     H           ;FOUND IT,GET STARTING ADD.
8DAF    5E                      MOV     E,M
8DB0    23                      INX     H
8DB1    66                      MOV     H,M
8DB2    6B                      MOV     L,E         ;AND SAVE IT
8DB3    22 5D 04                SHLD    SBSAV
8DB6    2A 59 04                LHLD    NXTSP       ;INIT MEMORY SCRATCH AREA
8DB9    22 88 04                SHLD    MESCR
8DBC    E1                      POP     H           ;GET SOURCE PNTR BACK
8DBD    7E              PARLP:  MOV     A,M         ;GET CHAR
8DBE    FE A9                   CPI     ')'+200Q    ;IS IT )?
8DC0    CA EC 8D                JZ      CLSUB       ;YES - GO CALL SUB
8DC3    FE AC                   CPI     ','+200Q    ;DO WE HAVE A ,?
8DC5    C2 44 87                JNZ     ER6         ;UEXPECTED CHARACTER
8DC8    CD 00 86                CALL    ICP7        ;BUMP PNTRS
8DCB    CD 8D 88                CALL    VAR         ;DO WE HAVE A VARIABLE
8DCE    D2 D5 8D                JNC     PREXP       ;NO
8DD1    D5                      PUSH    D           ;YES - SAVE ADDRESS
8DD2    C3 BD 8D                JMP     PARLP       ;CONTINUE
8DD5    CD E7 89        PREXP:  CALL    EVAL        ;EVALUATE EXPRESSION
8DD8    E5                      PUSH    H           ;SAVE H,L
8DD9    2A 88 04                LHLD    MESCR       ;GET SCRATCH AREA
8DDC    CD C3 87                CALL    COPDH       ;AND COPY TO IT
8DDF    D1                      POP     D           ;HL TO DE
8DE0    E5                      PUSH    H           ;SAVE ADDRESS
8DE1    23                      INX     H           ;UPDATE MESCR
8DE2    23                      INX     H
8DE3    23                      INX     H
8DE4    23                      INX     H
8DE5    22 88 04                SHLD    MESCR       ;SAVE IT
8DE8    EB                      XCHG                ;GET H,L BACK
8DE9    C3 BD 8D                JMP     PARLP       ;CONTINUE
8DEC    2A 5D 04        CLSUB:  LHLD    SBSAV       ;START OF ROUTINE
8DEF    E9                      PCHL                ;TRANSFER
```

```
                        ;GOSUB PROCESSOR
8DF0    21 A4 86        GOSUB:  LXI     H,ILOOP         ;FOR RETURN STMT.
8DF3    E5                      PUSH    H               ;TO STACK
8DF4    2A 56 04                LHLD    KFPNT           ;PNTR. TO NEXT STMT.
8DF7    E5                      PUSH    H               ;SAVE ON STACK
8DF8    2A 59 04                LHLD    NXTSP           ;CHECK MEMORY
8DFB    CD 1D 85                CALL    MEMFUL
8DFE    2A 5B 04                LHLD    CPNT            ;GET CHAR. PNTR
8E01    23                      INX     H
8E02    C3 1B 87                JMP     GSENT           ;PART OF GOTO TO FINISH
                        ;RETURN STMT. PROCESSOR
8E05    E1              RETRN:  POP     H               ;GET RETURN ADD. FROM STACK
8E06    C9                      RET                     ;CONTINUE
                        ;FOR STATEMENT PROCESSOR
8E07    2A 5B 04        FOR:    LHLD    CPNT            ;FIX PNTRS
8E0A    0C                      INR     C
8E0B    23                      INX     H
8E0C    23                      INX     H
8E0D    CD 00 86                CALL    ICP7
8E10    CD 25 82                CALL    ALPHA           ;LETTER?
8E13    D2 B5 8F                JNC     ER21            ;NO
8E16    46                      MOV     B,M             ;GET IT TO B
8E17    CD 00 86                CALL    ICP7            ;BUMP PNTR'S
8E1A    51                      MOV     D,C             ;SAVE C
8E1B    0E 00                   MVI     C,0             ;INIT C TO 0
8E1D    CD 17 82                CALL    NUMB            ;NUMBER?
8E20    D2 29 8E                JNC     $+9             ;NO
8E23    4E                      MOV     C,M             ;YES, GET IT
8E24    23                      INX     H               ;BUMP PNTR'S
8E25    15                      DCR     D
8E26    CA 08 8C                JZ      ER7             ;PREMATURE EOL
8E29    E5                      PUSH    H               ;SAVE H,L
8E2A    CD 17 86                CALL    FSYM            ;GET VAR. LOCATION
8E2D    E3                      XTHL                    ;PUT ON STACK, GET H,L
8E2E    59                      MOV     E,C             ;VARIABLE TO D,E
8E2F    4A                      MOV     C,D             ;RESTORE C
8E30    50                      MOV     D,B
8E31    EB                      XCHG                    ;SAVE VAR NAME
8E32    22 8C 04                SHLD    VNAME
8E35    EB                      XCHG                    ;RESTORE H,L
8E36    7E                      MOV     A,M             ;LOOK FOR =
8E37    FE BD                 CPI     '=' OR 200Q
8E39    C2 9C 8F              JNZ     ER16
8E3C    CD 00 86              CALL    ICP7          ;BUMP PNTR'S
8E3F    CD E7 89              CALL    EVAL          ;EVALUATE EXPRESSION
8E42    E3                    XTHL                  ;VARIABLE LOCATION
8E43    CD C3 87              CALL    COPDH         ;WRITE VALUE
8E46    22 8E 04              SHLD    VLOC          ;SAVE PNTR TO VARIABLE LOCATION
8E49    E1                    POP     H             ;GET H,L BACK
8E4A    79                    MOV     A,C           ;CHECK EOL
8E4B    B7                    ORA     A
8E4C    CA 08 8C              JZ      ER7
8E4F    3E 02                 MVI     A,2           ;CHECK FOR 'TO'
8E51    CD 00 83              CALL    SYMSRT
8E54    FE 07                 CPI     7
8E56    C2 A1 8F              JNZ     ER17
8E59    23                    INX     H             ;BUMB PNTR'S
8E5A    23                    INX     H
8E5B    79                    MOV     A,C           ;CHECK EOL
8E5C    B7                    ORA     A
8E5D    CA 08 8C              JZ      ER7
8E60    CD E7 89              CALL    EVAL          ;EVALUATE LIMIT
8E63    E5                    PUSH    H             ;SAVE H,L
8E64    21 90 04              LXI     H,FLIMT       ;SAVE LIMIT VALUE
8E67    CD C3 87              CALL    COPDH
8E6A    79                    MOV     A,C           ;CHECK EOL
8E6B    B7                    ORA     A
8E6C    C2 76 8E              JNZ     STP
8E6F    11 F5 8E              LXI     D,FONE        ;DEFAULT STEP=1
8E72    E1                    POP     H             ;RESTORE H,L
8E73    C3 8B 8E              JMP     FBILD
8E76    E1            STP:    POP     H             ;GET H,L
8E77    3E 02                 MVI     A,2           ;LOOK FOR 'STEP'
8E79    CD 00 83              CALL    SYMSRT
8E7C    FE 08                 CPI     8
8E7E    C2 A1 8F              JNZ     ER17
8E81    23                    INX     H             ;FIX H,L
8E82    23                    INX     H
8E83    23                    INX     H
8E84    0C                    INR     C             ;CHECK EOL
8E85    CD 00 86              CALL    ICP7
8E88    CD E7 89              CALL    EVAL          ;GET STEP SIZE
```

```
                                    ;AT THIS POINT:
                                    ;VARIABLE NAME IS IN LOCATION VNAME
                                    ;VARIABLE ADDRESS IS IN LOCATION VLOC
                                    ;VARIBLE HAS BEEN INITIALIZED
                                    ;LIMIT IS IN 4 BYTE LOCATION FLIMT
                                    ;STEP IS POINTED TO BY D,E
                                    ;H,L,C ARE POINTER, COUNTER AS USUAL
8E8B      D5                        FBILD:     PUSH    D                   ;SAVE PNTR TO STEP
8E8C      2A 8C 04                             LHLD    VNAME               ;GET VARIABLE NAME
8E8F      3E 3F                                MVI     A,77Q               ;MASK
8E91      A4                                   ANA     H                   ;MASK OFF TOP 2 BITS
8E92      47                                   MOV     B,A                 ;SET UP TO CALL FSYM
8E93      4D                                   MOV     C,L
8E94      CD 17 86                             CALL    FSYM                ;FIND ENTRY
8E97      DA AD 8E                             JC      FEXST               ;IT WAS THERE
8E9A      E5                                   PUSH    H                   ;IT WASN'T, SAVE H,L
8E9B      2A 59 04                             LHLD    NXTSP               ;UPDATE NXTSP
8E9E      3E 08                                MVI     A,8                 ;ADD 8 TO H,L
8EA0      85                                   ADD     L
8EA1      6F                                   MOV     L,A
8EA2      3E 00                                MVI     A,0
8EA4      8C                                   ADC     H
8EA5      67                                   MOV     H,A
8EA6      22 59 04                             SHLD    NXTSP               ;NEW VALUE OF NXTSP
8EA9      CD 1D 85                             CALL    MEMFUL              ;CHECK MEMORY
8EAC      E1                                   POP     H                   ;GET ADD. IN DATA BLOCK
8EAD      D1                        FEXST:     POP     D                   ;ADDRESS OF STEP SIZE
8EAE      CD C3 87                             CALL    COPDH               ;STORE IT
8EB1      23                                   INX     H                   ;PNT TO WHERE VAR. PNTR GOES
8EB2      23                                   INX     H
8EB3      23                                   INX     H
8EB4      23                                   INX     H
8EB5      3A 8E 04                             LDA     VLOC                ;FIRST BYTE
8EB8      77                                   MOV     M,A                 ;STORE IT
8EB9      23                                   INX     H
8EBA      3A 8F 04                             LDA     VLOC+1              ;SECOND BYTE
8EBD      77                                   MOV     M,A
8EBE      23                                   INX     H                   ;PNT TO WHERE LIMIT GOES
8EBF      11 90 04                             LXI     D,FLIMT             ;WHERE IT IS NOW
8EC2      CD C3 87                             CALL    COPDH               ;COPY IT
8EC5      23                                   INX     H                   ;PNT TO WHERE KFPNT GOES
```

```
8EC6    23                      INX     H
8EC7    23                      INX     H
8EC8    23                      INX     H
8EC9    3A 56 04                LDA     KFPNT              ;1ST BYTE
8ECC    77                      MOV     M,A
8ECD    23                      INX     H
8ECE    3A 57 04                LDA     KFPNT+1            ;2ND BYTE
8ED1    77                      MOV     M,A
                        ;PUT CURRENT VNAME ON NESTING STACK
8ED2    21 00 00                LXI     H,0                ;GET STACK-POINTER
8ED5    39                      DAD     SP
8ED6    22 8E 04                SHLD    VLOC               ;SAVE IT
8ED9    2A 94 04                LHLD    NEST               ;GET NEST SP
8EDC    7D                      MOV     A,L                ;COMPARE WITH STACK LIMIT
8EDD    FE 96                   CPI     TOPNS AND 377Q     ;NEED ONLY COMPARE PAGE LOCATION
8EDF    CA A6 8F                JZ      ER18               ;FOR'S NEXTED TOO DEEPLY
8EE2    F9              NSTOK:  SPHL                       ;LOAD NEW SP
8EE3    EB                      XCHG                       ;SAVE NEST SP
8EE4    2A 8C 04                LHLD    VNAME              ;GET INDEX NAME
8EE7    E5                      PUSH    H                  ;SAVE IT
8EE8    1B                      DCX     D                  ;UPDATE NEST SP
8EE9    1B                      DCX     D
8EEA    EB                      XCHG                       ;SAVE IT
8EEB    22 94 04                SHLD    NEST
8EEE    2A 8E 04                LHLD    VLOC               ;RESTORE OLD SP
8EF1    F9                      SPHL
8EF2    C3 AC 8B                JMP     IEND               ;ALL DONE
8EF5    80 00 00 01     FONE:   DB      200Q,0,0,001Q      ;FLOATING PNT ONE
                        ;NEXT STATEMENT PROCESSOR
8EF9    2A 5B 04        NEXT:   LHLD    CPNT               ;FIX PNTR'S
8EFC    23                      INX     H
8EFD    23                      INX     H
8EFE    23                      INX     H
8EFF    0C                      INR     C
8F00    CD 00 86                CALL    ICP7
8F03    CD 25 82                CALL    ALPHA              ;LETTER?
8F06    D2 B5 8F                JNC     ER21               ;NO, ERROR
8F09    46                      MOV     B,M                ;YES, GET IT
8F0A    51                      MOV     D,C                ;SAVE C
8F0B    0E 00                   MVI     C,0                ;INIT C TO 0
8F0D    23                      INX     H                  ;BUMP PNTR'S
```

```
8F0E      15                      DCR     D
8F0F      CA 1D 8F                JZ      NEXT1
8F12      CD 17 82                CALL    NUMB                 ;NUMBER?
8F15      D2 B5 8F                JNC     ER21                 ;NO, ERROR
8F18      4E                      MOV     C,M                  ;YES, GET IT
8F19      15                      DCR     D                    ;SHOULD BE EOL
8F1A      C2 B5 8F                JNZ     ER21
8F1D      21 00 00       NEXT1:   LXI     H,0                  ;GET SP
8F20      39                      DAD     SP
8F21      22 8E 04                SHLD    VLOC                 ;SAVE IT
8F24      2A 94 04                LHLD    NEST                 ;GET NEST SP
8F27      7D                      MOV     A,L                  ;COMPARE WITH BOTTOM
8F28      FE AA                   CPI     BOTNS AND 377Q
8F2A      CA AB 8F                JZ      ER19                 ;NEXT BEFORE FOR
8F2D      F9                      SPHL                         ;LOAD SP
8F2E      E1                      POP     H                    ;GET LAST INDEX
8F2F      78                      MOV     A,B                  ;COMPARE TO CURRENT
8F30      BC                      CMP     H
8F31      C2 B0 8F                JNZ     ER20                 ;NESTING ERROR
8F34      79                      MOV     A,C
8F35      BD                      CMP     L
8F36      C2 B0 8F                JNZ     ER20
8F39      2A 8E 04                LHLD    VLOC                 ;ALL OK, RESTORE OLD SP
8F3C      F9                      SPHL
8F3D      3E 3F                   MVI     A,77Q                ;MASK
8F3F      A0                      ANA     B                    ;MASK OUT TOP 2 BITS
8F40      47                      MOV     B,A
8F41      CD 17 86                CALL    FSYM                 ;FIND SYMBOL
8F44      EB                      XCHG                         ;ADDRESS TO D,E
8F45      21 7C 04                LXI     H,FREG1              ;COPY STEP TO FREG1
8F48      CD C3 87                CALL    COPDH
8F4B      13                      INX     D                    ;PNT TO CHARACTERISTIC OF STEP
8F4C      13                      INX     D
8F4D      13                      INX     D
8F4E      1A                      LDAX    D                    ;GET IT
8F4F      E6 80                   ANI     200Q                 ;GET SIGN
8F51      17                      RAL                          ;ROTATE IT INTO CARRY
8F52      3F                      CMC                          ;COMPLEMENT IT
8F53      3E 00                   MVI     A,0                  ;MAKE SURE A=0
8F55      17                      RAL                          ;ROTATE TO LSB
8F56      3C                      INR     A                    ;BUMP BY ONE
```

```
8F57    32 8E 04                STA     VLOC            ;SAVE IT, ITS =1 IF - STEP,
8F5A    13                      INX     D               ;ELSE = 2 PNT TO VARIABLE PNTR
8F5B    EB                      XCHG                    ;GET IT TO DE
8F5C    5E                      MOV     E,M
8F5D    23                      INX     H
8F5E    56                      MOV     D,M
8F5F    23                      INX     H
8F60    E5                      PUSH    H               ;SAVE DATA BLOCK PNTR.
8F61    21 80 04                LXI     H,FREG2         ;COPY VARIBLE VALUE TO FREG2
8F64    CD C3 87                CALL    COPDH           ;SAVE VARIABLE LOCATION IN H,L
8F67    EB                      XCHG
8F68    3E 02                   MVI     A,2             ;SET UP TO ADD
8F6A    CD 5B 8A                CALL    BINOP           ;AND DO IT
8F6D    CD C3 87                CALL    COPDH           ;COPY TO VARIABLE
8F70    21 7C 04                LXI     H,FREG1         ;AND TO FREG1 FOR COMPARE
8F73    CD C3 87                CALL    COPDH
8F76    D1                      POP     D               ;PNT TO LIMIT
8F77    21 80 04                LXI     H,FREG2         ;COPY TO FREG2
8F7A    CD C3 87                CALL    COPDH
8F7D    D5                      PUSH    D               ;SAVE DATA BLOCK PNTR
8F7E    CD 43 8D                CALL    FCOMP           ;COMPARE
8F81    21 8E 04                LXI     H,VLOC          ;COMPARE WITH STEP TYPE
8F84    BE                      CMP     M
8F85    E1                      POP     H               ;GET DATA BLOCK PNTR.
8F86    CA 94 8F                JZ      NXTDN           ;YES => LOOP DONE
8F89    23                      INX     H               ;LOOP NOT DONE
8F8A    23                      INX     H               ;PNT TO TRANSFER ADD.
8F8B    23                      INX     H
8F8C    23                      INX     H
8F8D    5E                      MOV     E,M             ;GET IT TO H,L
8F8E    23                      INX     H
8F8F    56                      MOV     D,M
8F90    EB                      XCHG
8F91    C3 A4 86                JMP     ILOOP
8F94    21 94 04        NXTDN:  LXI     H,NEST          ;POP NEST STACK
8F97    34                      INR     M
8F98    34                      INR     M
8F99    C3 AC 8B                JMP     IEND            ;CONTINUE
8F9C    3E 16           ER16:   MVI     A,16H           ;'=' EXPECTED(NOTE: NO ARRAY
8F9E    C3 C8 85                JMP     ERROR           ;ELEMENTS FOR INDICES)
8FA1    3E 17           ER17:   MVI     A,17H           ;BAD SYNTAX NEAR 'TO' OR 'STEP'
```

```
8FA3    C3 C8 85                 JMP     ERROR             ;IN FOR STATEMENT
8FA6    3E 18           ER18:    MVI     A,18H             ;FOR'S NESTED TOO DEEPLY
8FA8    C3 C8 85                 JMP     ERROR
8FAB    3E 19           ER19:    MVI     A,19H             ;'NEXT' EXECUTED BEFORE A 'FOR'
8FAD    C3 C8 85                 JMP     ERROR
8FB0    3E 20           ER20:    MVI     A,20H             ;NESTING ERROR, 'FOR'-'NEXT'
8FB2    C3 C8 85                 JMP     ERROR
8FB5    3E 21           ER21:    MVI     A,21H             ;BAD INDEX IN FOR-NEXT
8FB7    C3 C8 85                 JMP     ERROR
                        ;
                        ; THIS SUB CHECKS FOR PAGE BOUNDARY CROSSING
                        ; OF VARIABLE STORAGE BEFORE UPDATING
                        ; FORWARD POINTER
                        ;    D-E  POINT TO CURRENT LOCATION OF NEXT VARIABLE
                        ;    H-L  POINT TO PREVIOUS VARIABLE LOCATION
                        ;
                        ;  MODIFY D-E ( IF NECESSARY ) SO VARIABLE WILL NOT CROSS PAGE
                        ;  BOUNDARY
8FBA                    CHKLC:
8FBA    F5                       PUSH    PSW
8FBB    D5                       PUSH    D                ; SEE IF CURRENT VARIABLE
8FBC    3E 07                    MVI     A,7              ; STORAGE 8 WORD BLOCK
8FBE    83                       ADD     E                ; WILL CROSS PAGE BOUNDARY
8FBF    DA C5 8F                 JC      CHOVL
                        ;  OK  -  DOES NOT CROSS PAGE
8FC2    D1                       POP     D
8FC3    F1                       POP     PSW
8FC4    C9                       RET
                        ;  PAGE BOUNDARY CROSSED  -  SET D-E TO START OF NEXT PAGE
8FC5                    CHOVL:
8FC5    D1                       POP     D
8FC6    14                       INR     D
8FC7    1E 00                    MVI     E,0
8FC9    F1                       POP     PSW
8FCA    C9                       RET
                        ;
                        ;  THIS SUB IS CALLED FROM 'DIM' PROCESSOR
                        ;  REGS. 'D-E' POINT TO NEXT AVAILABLE WORD OF VARIABLE STORAGE
                        ;  THIS SUB MAKES SURE THAT STORAGE STARTS ON A 4-WORD
                        ;  BOUNDARY SO FLT. PT. NUMBER WILL NOT CROSS PAGE
                        ;
```

```
8FCB                         CKDIM:
8FCB       7B                         MOV     A,E
8FCC       E6 03                      ANI     3
8FCE       C8                         RZ
8FCF       7B                         MOV     A,E
8FD0       E6 FC                      ANI     374Q
8FD2       C6 04                      ADI     4
8FD4       5F                         MOV     E,A
8FD5       7A                         MOV     A,D
8FD6       CE 00                      ACI     0
8FD8       57                         MOV     D,A
8FD9       C9                         RET

                             ; CALL ROUTINES

8FDA       AA 04             FWAM:   DW VEND                 ;DEFINE FWAM POINTER

                                     END
NO PROGRAM ERRORS

                          SYMBOL TABLE

 * 01

 A       0007      ADDD    8A76      ADFLD   8B32      AFOND   892F
 AGA     8A22      ALPHA   8225      AR      861E      ARCK    88D9
 ARYES   88ED      ASBC    8A79      B       0000      BAC     8223
 BINOP   8A5B      BMPTR   89DB      BND1    8576 *    BND2    85AD
 BND3    85B0      BOTNS   04AA      BOUND   8557      BUPT    88B0 *
 C       0001      C1      821C      CALLP   8D7A      CHOVL   8FC5
 CHAR2   97F7      CHAR5   8517      CHEKE   89D1      CHK1    82A6
 CHKLC   8FBA      CHKMD   89A7      CHPAR   0BB2      CKDIM   8FCB
 CLSUB   8DEC      CONIN   0104      CONOU   0107      CONT    8796
 CONV    97E5      COPD1   87C9      COPDH   87C3      CPNT    045B
 CREG    0484      CVB     822D      CVB1    824E      CVB2    826B
 D       0002      DCOMP   97F1      DFXL    97DC      DIM     8738
 DIV     8AAD      DLOOP   873E      DOL     8A0C      E       0003
 ECAV    89F1      ENDD    870A      ENTRY   867E      EOK     8A1A *
 ER10    8C98      ER14    8CC3      ER16    8F9C      ER17    8FA1
 ER18    8FA6      ER19    8FAB      ER20    8FB0      ER21    8FB5
 ER6     8744      ER7     8C08      ER8     8A42      ER9     8888
```

```
ERLN    85E9        ERRET   8BE8        ERRØR   85C8        ERRR1   85DC
EVAL    89E7        EXPRE   8AF6        F1      845D        FALSE   8D32
FBAC    8683        FBILD   8E8B        FCØMP   8D43        FDAT    898F
FEXST   8EAD        FINPT   97E8        FIX     8935        FLDFD   8B4D
FLIMT   0490        FLØAT   97CA  *     FMULT   8AA7        FNDSB   8DAE
FØNE    8EF5        FØR     8E07        FØR10   8450        FØR11   844F
FØR12   844E        FØRM1   8457        FØRM2   8456        FØRM3   8455
FØRM4   8454        FØRM5   8458        FØRM6   845E        FØRM7   8453
FØRM8   8452        FØRM9   8451        FØUND   82A3        FPERR   8A7B
FREG1   047C        FREG2   0480        FSYM    8617        FWAM    8FDA
GET     87F4        GKEY    86DE        GØØD    8952        GØSUB   8DF0
GØTØ    8718        GREG    0477        GSENT   871B        GTRA    8721
H       0004        HLINP   0486        HØME    883F        HSRDR   010D
HSRIN   84E4        IAGA    8CAD        IBUF    0401        ICP2    860F
ICP4    860A        ICP7    8600        ICP8    8605        IDØNE   89A3
IEND    8BAC        IFRT    8C9D        II1     8CC8        ILØØP   86A4
INCPT   8611        INP     8993  *     INPER   8B70        INPØK   8BA9
INPUT   8B6C        INSER   8090        ISR10   816C        ISR11   8172
ISR12   817B        ISR1A   80A3        ISRT1   80BE        ISRT2   80C5
ISRT3   80D5        ISRT4   80D8        ISRT5   8110        ISRT6   8122
ISRT7   8145        ISRT8   8149        ISRT9   8153        JTBL    86EE
KASE    0460        KDAT1   8358        KDAT2   836D        KDAT3   83A7
KDAT4   83C9        KDATA   8354        KFPNT   0456        KL2     0454
KL4     0456        KL6     0458  *     KLEN    0458        KLINE   0452
KØNT    8856        L       0005        L1      86C6        L2      828E
LADD    97D0        LDIV    97D6        LEN     0461        LENGT   8274
LET     8BFD        LIS1    81EB        LIST    81D2        LMCM    97DF
LMUL    97D3        LØK     8C0D        LPNT    0452        LSUB    97D9
LUKØN   8631        M       0006        M1      8000        M1A     8013
M2      8017        M3      8020        M4      8043        M4A     8048
MCHK    97F4  *     MDBC    8AB0        MEMFU   851D        MEMST   0400
MESCR   0488        MINSE   8950        MØDE    0485        MØDE1   89B7
MØRE    889F        MULT    97EB        MULT1   0462        MULT2   0464
NDØU    8777        NEST    0494        NEXT    8EF9        NEXT1   8F1D
NFPER   8A9E        NL2     044D        NL4     044F  *     NL6     0451
NLE1    8278        NLE2    8287        NLINE   044B        NØENT   8650
NØLIN   8192        NØMAT   8645        NØRM    97C7  *     NØSYM   864E
NØT3    8D28        NSRCH   828B        NSTØK   8EE2  *     NUMB    8217
NUSUB   8D9D        NXTDN   8F94        NXTSP   0459        ØBUFF   0400
ØDA10   84DA        ØDAT1   8473        ØDAT2   8479        ØDAT3   8487
ØDAT4   8490        ØDAT5   849A        ØDAT6   84A0        ØDAT7   84AF
```

```
ODAT8   84C6       ODAT9   84D1       ODATA   8469       OKK     8862
OKLET   8749       OKN     872D       ONWD    8B45  *    OUTR    87D6  *
P1      82BB       P2      82C5       PAD     82B0       PARLP   8DBD
PEND    8B66       PIN1    84EA       PIN1A   84ED       PIN3    850F
PINST   8C93       PK1     8427       PK2     8444       PL2     045B  *
PL4     045D       PL6     045F       PLINE   0459       PLOOP   8ACE
PREXP   8DD5       PRI     8AB5       PRI1    8C83       PRMPT   8B7C
PRTIT   8B0D       PSW     0006       PT1     806E       PTAPE   8066
PTFIN   8C6C       PTVAL   97EE       QCHEK   8AE8       QOTOK   8ADD
QSTR1   843F       QSTRG   843A       QTCHK   8211  *    QUITT   8209
QUOTE   8AD4       RDKON   886E       RELAT   8CF5       RETRN   8E05
RINST   8851       RUN     8685       S2      8310  *    S3      8311
S4      832C       S4A     832B       S5      8348       SAVV    8C52
SBSAV   045D       SC1     8896       SCALR   88D1       SCOLN   8B27
SCR     0466       SFSG    88B4       SINEQ   8D5B       SLOAD   88CA
SONWD   8B59       SORCE   86B2       SP      0006       SPACE   89A1
SPNT    0100       STAC    0496       STATU   010A       STLIN   0449
STNER   8BEB       STOKK   8BCF       STOKV   8BC0       STP     8E76
STPNT   818C       STRIN   8BB2       STSIZ   0014       STSPA   044B
SUBAD   0102       SUBB    8AA1       SYMSR   8300       TAPE    81AB
THEN    8D39       TIN1    83D5       TIN2    83FF       TIN4    8415
TIN4A   841A       TIN5    840C       TIN5A   8411       TOPNS   0496
TRUE    8D36       TTYIN   83D2       V1      8830       VALUE   87DE
VAR     888D       VARAD   048A       VEND    04AA       VLOC    048E
VNAME   048C       W1      82E2       W2      82F9       WFOR    8A47
WFPER   8A97       WHAT    819F       WRIT    82D3       WRIT1   82D5
ZROL    97CD

* 02

* 03

* 04

* 05

* 06
* 07

* 08

* 09

* 10

* 11
```

ODT

```
                                                      ;ODT PROGRAM FOR THE MCS-80
                                                      ;***********AUTHOR EUGENE R FISHER***********
                                                        ;4-20-74
0000                                 ORG 0
0002                       TTY EQU 2
0006                       SND EQU 6
0003                       FLAG EQU 3
                           ;;
0000    31 FF 3F           ERROR:    LXI  SP,37777Q    ;SET STACK POINTER,PAGE77,LOC 377
0003    3E BF                        MVI  A,277Q       ;SEND A ?
0005    C3 3F 00                     JMP  ERR
0008    C3 08 08                     JMP  4010Q         ;FIRST RESTART LOCATION
000B    00                           NOP
000C    00                           NOP
000D    00                           NOP
000E    00                           NOP
000F    00                           NOP
0010    C3 10 08                     JMP  4020Q
0013    00                           NOP
0014    00                           NOP
0015    00                           NOP
0016    00                           NOP
0017    00                           NOP
```

```
0018      C3 18 08                   JMP 4030Q
001B      00                         NOP
001C      00                         NOP
001D      00                         NOP
001E      00                         NOP
001F      00                         NOP
0020      C3 20 08                   JMP 4040Q
0023      00                         NOP
0024      00                         NOP
0025      00                         NOP
0026      00                         NOP
0027      00                         NOP
0028      C3 28 08                   JMP 4050Q
002B      00                         NOP
002C      4D                PER:    MOV C,L             ;ROUTINE TO MAKE PERIOD CURRENT LOCATION
002D      C3 47 00                  JMP NEXTC
0030      C3 E4 00          SEND:   JMP SEN             ;ENTRY POINT TO SEND ROUTINE
0033      CD F8 00          GO:     CALL CRLF           ;SEND A CRLF
0036      69                        MOV L,C             ;SET THE L REG
0037      E9                         PCHL      ;JMP TO STARTING ADDRESS
0038      E3               TRAP:     XTHL                ;CHANGE ORDER OF STACK H AND L LAST OUT
0039      D5                         PUSH D              ;FORTH OUT
003A      C5                         PUSH B               ;THIRD OUT
003B      F5                         PUSH     PSW            ;SECOND OUT
003C      E5                         PUSH H              ;FIRST OUT IS THE ADR WHENCE WE CAME
003D      3E D4                      MVI A,324Q  ;SEND A T
                                    ;
                               ;THE STACK MAY BE DUMPED BY HITTING A CTRL-C TO GET THE
                               ; FOLLOWING SP+1  SP A F B C D E H L
                                    ;
003F      F7               ERR:     RST SND
0040      CD F8 00                  CALL CRLF
0043      AF                BEGIN:  XRA A               ;CLEAR THE AC
0044      16 04             BEG:    MVI D,4
0046      4F                SAV:    MOV C,A
0047      CD DB 00          NEXTC:  CALL READ
004A      78                        MOV A,B
004B      D6 B8                     SUI 270Q            ;IS IT A NUMBER
004D      F2 94 00                  JP  TERM            ;270 MUST BE TERMINATOR OR ILLEGAL DIGIT
0050      78                        MOV A,B
0051      D6 B0                     SUI 260Q
```

```
0053    FA 94 00                JM   TERM       ;YES
0056    15                      DCR  D          ;>260 MUST BE DIGIT BUMP BUFFER CNT
0057    CA 00 00                JZ   ERROR      ;BUFFER OVERFLOW
005A    47                      MOV  B,A
005B    79                      MOV  A,C        ;GET PREVIOUS INPUTS
005C    17                      RAL
005D    17                      RAL
005E    17                      RAL
005F    DA 00 00                JC   ERROR      ;IF CARRY NUMBER WAS TOO BIG
0062    80                      ADD  B
0063    C3 46 00                JMP  SAV
0066    69            SLASH:    MOV  L,C        ;C CONTAINS ADDRESS
0067    7E            GETCON:   MOV  A,M        ;GET CONTENTS
0068    CD C1 00                CALL OCTALP
006B    3E A0                   MVI  A,240Q
006D    F7                      RST  SND
006E    C3 43 00                JMP  BEGIN
0071    7A            LF:       MOV  A,D
0072    D6 04                   SUI  4
0074    CA 78 00                JZ   NINP       ;IF CNT STILL 4 NO INPUT WAS RECEIVED
0077    71                      MOV  M,C        ;IF CNT <4 DEPOSIT ONPUT IN MEMORY
0078    3E 8D         NINP:     MVI  A,215Q
007A    F7                      RST  SND
007B    2C                      INR  L          ;BUMP ADDRESS
007C    7C                      MOV  A,H        ;GET HI PART
007D    CD C1 00                CALL OCTALP     ;TYPE HI ADDRESS
0080    7D                      MOV  A,L        ;GET LOW PART
0081    CD C1 00                CALL OCTALP     ;TYPE LOW ORDER ADDRESS
0084    C3 67 00                JMP  GETCON
0087    CD F8 00      CR:       CALL CRLF       ;SEND A CRLF
008A    7A                      MOV  A,D
008B    D6 04                   SUI  4          ;BUFCNT =4 ?
008D    CA 43 00                JZ   BEGIN      ;YES NO INPUT SINCE LAST TERMINATOR
0090    71                      MOV  M,C        ;LOAD MEMORY WITH INPUT
0091    C3 43 00                JMP  BEGIN      ;ERF
0094    78            TERM:     MOV  A,B
0095    FE 8A                   CPI  212Q       ;IS IT A LF
0097    CA 71 00                JZ   LF
009A    FE 8D                   CPI  215Q       ;IS IT RETURN
009C    CA 87 00                JZ   CR
009F    FE D2                   CPI  322Q       ;R
```

```
00A1   CA 00 02           JZ  1000Q        ;START READER PROGRAM
00A4   FE AF              CPI  257Q
00A6   CA 66 00           JZ   SLASH
00A9   FE C7              CPI  307Q
00AB   CA 33 00           JZ   GO           ;G
00AE   FE AE              CPI  256Q         ;PERIOD
00B0   CA 2C 00           JZ   PER
00B3   FE 83              CPI  203Q
00B5   CA EF 00           JZ   CTRLC        ;CONTROL C
00B8   FE D3              CPI  323Q         ;S
00BA   C2 00 00           JNZ ERROR         ;FOUND AN ERROR
00BD   61         SETX:   MOV H,C          ;SAME HI ADDRESS
00BE   C3 40 00           JMP ERR+1
00C1   06 04     OCTALP:  MVI  B,4          ;SET CNTR
00C3   07                 RLC
00C4   07                 RLC
00C5   5F                 MOV  E,A          ;SAVE AC
00C6   3E A0              MVI  A,240Q       ;SEND A SPACE
00C8   F7                 RST  SND
00C9   7B                 MOV  A,E          ;GET THE AC
00CA   E6 03              ANI  3            ;MASK
00CC   05        DECR:    DCR  B            ;DECR
00CD   C8                 RZ                ;DONE ?
00CE   C6 B0              ADI  260Q         ;NO
00D0   F7                 RST  SND     ;SEND A CHARAACTER
00D1   7B                 MOV  A,E          ;GET AC
00D2   07                 RLC
00D3   07                 RLC
00D4   07                 RLC
00D5   5F                 MOV  E,A          ;SAVE AC
00D6   E6 07              ANI  7            ;MASK
00D8   C3 CC 00           JMP  DECR
00DB   DB 03     READ:    IN  FLAG          ;ROUTINE TO READ ONE CHAR FROM TTY
00DD   1F                 RAR
00DE   D2 DB 00           JNC  READ
00E1   DB 02              IN  TTY
00E3   47                 MOV  B,A
00E4   D3 02      SEN:    OUT  TTY          ;ROUTINE TO OUTPUT AN ASCII CHAR
00E6   DB 03     SEN1:    IN  FLAG
00E8   1F                 RAR
00E9   1F                 RAR
```

```
 00EA      78                           MOV A,B               ;RESTORE A REG FROM READ
 00EB      D8                           RC                    ;DONE?
 00EC      C3 E6 00                     JMP SEN1              ;NO
 00EF      E1                 CTRLC:    POP H
 00F0      7C                           MOV A,H
 00F1      CD C1 00                     CALL OCTALP
 00F4      7D                           MOV A,L
 00F5      C3 68 00                     JMP GETCON+1
 00F8      3E 8D               CRLF:    MVI A,215Q          ;SEND A CRLF
 00FA      F7                           RST SND
 00FB      3E 8A                        MVI A,212Q
 00FD      C3 E4 00                     JMP SEN             ;RETURN VIA SEND
                                        END
NO PROGRAM ERRORS

                        SYMBOL TABLE

 * 01

 A       0007      B       0000      BEG     0044 *    BEGIN   0043
 C       0001      CR      0087      CRLF    00F8      CTRLC   00EF
 D       0002      DECR    00CC      E       0003      ERR     003F
 ERROR   0000      FLAG    0003      GETCO   0067      GO      0033
 H       0004      L       0005      LF      0071      M       0006
 NEXTC   0047      NINP    0078      OCTAL   00C1      PER     002C
 PSW     0006      READ    00DB      SAV     0046      SEN     00E4
 SEN1    00E6      SEND    0030 *    SETX    00BD *    SLASH   0066
 SND     0006      SP      0006      TERM    0094      TRAP    0038 *
 TTY     0002
```

```
                           ;       ////FLOATING POINT PACKAGE FOR THE MCS8
                           ;       ////BY DAVID MEAD
                           ;       ////MODIFIED BY HAL BRAND 9/6/74
                           ;       ////MODIFIED FOR 24 BIT MANTISSAS***********
                           ;       ////PLUS ADDED I/O CONVERSION ROUTINES
                           ;       ////NEW ROUTINE COMMENTS
                           ;       ////ARE PRECEEDED BY /
                           ;       ////OTHER CHANGES ARE NOTED BY **
                          ;        ////MODIFIED BY FRANK OLKEN 6/28/75
                           ;
                           ;
9000                               ORG 110000Q
                           ;
                           ;
0104                      CONIN    EQU     404Q       ; JMP TABLE LOCATION OF CONSOLE INP.
010A                      STATUS   EQU     412Q       ; JMP TABLE LOC. FOR STATUS PORT INPUT
97FD                      OUTR     EQU     113775Q          ;LINK TO BASIC
87D6                      OUTL     EQU     103726Q
8993                      INL      EQU     104623Q
97FA                      INP      EQU     113772Q          ;LINK TO BASIC
00C0                      MINCH    EQU     300Q       ;MINIMUM CHARACTERISTIC WITH SIGN EXTENDED
003F                      MAXCH    EQU     077Q       ;MAXIMUM CHARACTERISTIC WITH SIGN EXTENDED
                           ;
                           ;******************************************************
                           ;       //// DIVIDE SUBROUTINE
                           ;******************************************************
                           ;
9000        CD 69 93      LDIV:    CALL    CSIGN      ;COMPUTE SIGN OF RESULT
9003        CD DA 91               CALL    ZCHK       ;CHECK IF DIVIDEND = ZERO
9006        C2 12 90               JNZ     DTST2      ;IF DIVIDEND .NE. 0 CHECK DIVISOR
9009        CD E2 91               CALL    BCHK       ;CHECK FOR ZERO/ZERO
900C        CA A8 92               JZ      INDFC      ;ZERO/ZERO = INDEFINITE
900F        C3 AF 92               JMP     WZERC      ;ZERO/NONZERO = ZERO
9012        CD E2 91      DTST2:   CALL    BCHK       ;COME HERE IF DIVIDEND .NE. 0
9015        CA 5B 93               JZ      OFLWC      ;NONZERO/ZERO = OVERFLOW
                                                      ;IF WE GET HERE, THINGS LOOK OKAY
```

```
9018    5D                      MOV     E,L        ;SAVE BASE IN E
9019    69                      MOV L,C           ;BASE 6 TO L
901A    CD 1D 92                CALL DCLR         ;CLEAR QUOTIENT MANTISSA SLOT
901D    6B                      MOV L,E           ;RESTORE BASE IN L
901E    CD 10 93                CALL ENT1         ;DO FIRST CYCLE
9021    69                      MOV L,C           ;BASE  6 TO L
9022    CD E9 91                CALL DLST         ;MOVE QUOTIENT OVER ONE PLACE
9025    16 17                   MVI D,23          ;NUMBER OF ITERATIONS TO D
9027    6B             REP3:    MOV L,E
9028    CD 0A 93                CALL ENT2
902B    15                      DCR D             ;DEC D
902C    CA 3B 90                JZ  GOON
902F    7D                      MOV A,L
9030    69                      MOV L,C           ;BASE 6 TO L
9031    4F                      MOV C,A
9032    CD E9 91                CALL DLST         ;MOVE QUOTIENT MANT OVER
9035    7D                      MOV A,L           ;CPTR TO A
9036    59                      MOV E,C           ;LPTR TO E
9037    4F                      MOV C,A           ;CPTR TO C
9038    C3 27 90                JMP REP3
                       ;
903B    CD E1 92       GOON:     CALL    AORS           ;CHECK IF RESULT IS NORMALIZED
903E    FA 4D 90                JM  CRIN
9041    7D                      MOV A,L           ;LPTR TO A
9042    69                      MOV L,C           ;CPTR TO L
9043    4F                      MOV C,A           ;LPTR TO C
9044    CD E9 91                CALL DLST         ;SHIFT QUOTIENT LEFT
9047    4D                      MOV C,L
9048    6B                      MOV L,E
9049    CD 39 93                CALL     LDCP       ;COMPUTE THE CHARACTERISTIC OF RESULT
904C    C9                      RET
                       ;
904D    CD 4C 92       CRIN:     CALL    CFCHE          ;GET A=CHAR(H,L), E=CHAR(H,B)
9050    93                      SUB      E          ;NEW CHAR = CHAR(DIVIDEND) -
9051    FE 7F                   CPI      177Q       ;CHAR(DVISIOR) CHECK MAX POSITIVE NUMBER
9053    CA 5B 93                JZ       OFLWC      ;JUMP ON OVERFLOW
9056    C6 01                   ADI      1          ;ADD 1 SINCE WE DID NOT LEFTSHIFT
9058    CD 44 93                CALL     CCHK       ;CHECK AND STORE CHARACTERISTIC
905B    C9                      RET                 ;RETURN
                       ;
                        ;
```

```
                          ;
                          ;*******************************************************
                          ;       //// ADDITION SUBROUTINE
                          ;*******************************************************
                          ;
                          ;
905C      AF              LADD:   XRA A                ;/***SET UP TO ADD
905D      C3 62 90                JMP LADS             ;/NOW DO IT
                          ;
                          ;
                          ;*******************************************************
                          ;       //// SUBTRACTION SUBROUTINE
                          ;*******************************************************
                          ;
                          ;
9060      3E 80           LSUB:   MVI A,200Q             ;/****SET UP TO SUBTRACT
                          ;                             SUBROUTINE LADS
                          ;                             FLOATING POINT ADD OR SUB
                          ;                             A 128 ON ENTRY SUB
                          ;                             A 0 ON ENTRY ADD
                          ;                             F-S F,FIRST OPER DESTROYED
                          ;                             BASE  11 USED FOR SCRATCH
9062      CD EF 92        LADS:   CALL ACPR              ;SAVE ENTRY PNT AT BASE  6
9065      CD E2 91                CALL    BCHK             ;CHECK ADDEND/SUBTRAHEND = ZERO
9068      C8                      RZ                       ;IF SO, RESULT=ARG SO RETURN
                                                           ;THIS WILL PREVENT UNDERFLOW
                                                           ;INDICATION ON ZERO + OR - ZERO
9069      CD 5B 92                CALL CCMP
906C      CA 9C 90                JZ  EQ02               ;IF EQUAL, GO ON
906F      57                      MOV D,A                ;SAVE LPTR CHAR IN D
9070      DA 7F 90                JC  LLTB
9073      93                      SUB E                  ;L.GT.B IF HERE
9074      E6 7F                   ANI 127
9076      57                      MOV D,A                ;DIFFERENCE TO D
9077      5D                      MOV E,L                ;SAVE BASE IN E
9078      69                      MOV L,C                ;C PTR TO L
9079      2C                      INR L                  ;C PTR 1 TO L
907A      73                      MOV M,E                ;SAVE BASE IN C PTR 1
907B      68                      MOV L,B                ;B PTR TO L
907C      C3 84 90                JMP NCHK
907F      7B              LLTB:   MOV A,E                ;L.LT.B IF HERE,BPTR TO A
```

```
9080     92                    SUB D          ;SUBTRACT LPTR CHAR FROM BPTR CHAR
9081     E6 7F                 ANI 127
9083     57                    MOV D,A        ;DIFFERENCE TO D
9084     3E 18         NCHK:   MVI A,24
9086     BA                    CMP D
9087     D2 8C 90              JNC SH10
908A     16 18                 MVI D,24
908C     B7            SH10:   ORA A
908D     CD F8 91              CALL DRST
9090     15                    DCR D
9091     C2 8C 90              JNZ SH10
9094     7D            EQUL:   MOV A,L
9095     B8                    CMP B
9096     C2 9C 90              JNZ EQ02       ;F.GT.S IF L.NE.B
9099     69                    MOV L,C        ;C PTR TO L
909A     2C                    INR L          ;C PTR 1 TO L
909B     6E                    MOV L,M        ;RESTORE L
909C     CD 02 91      EQ02:   CALL LASD      ;CHECK WHAT TO
909F     CD EF 92              CALL ACPR      ;SAVE ANSWER
90A2     FE 02                 CPI 2          ;TEST FOR ZERO ANSWER
90A4     C2 AA 90              JNZ NOTO
90A7     C3 8D 92              JMP     WZER     ;WRITE FLOATING ZERO AND RETURN
                      ;
90AA     16 01          NOTO:  MVI D,1        ;WILL TEST FOR SUB
90AC     A2                    ANA D
90AD     CA D6 90              JZ  ADDZ       ;LSB 1 INPLIES SUB
90B0     CD E7 92              CALL TSTR      ;CHECK NORMAL/REVERSE
90B3     CA B9 90              JZ  SUBZ       ;IF NORMAL,GO SUBZ
90B6     7D                    MOV A,L        ;OTHERWISE REVERSE
90B7     68                    MOV L,B        ;ROLES
90B8     47                    MOV B,A        ;OF L AND B
                      ;
90B9     CD 26 92      SUBZ:   CALL    DSUB     ;SUBTRACT SMALLER FROM BIGGER
90BC     CD EF 90              CALL    MANT     ;SET UP SIGN OF RESULT
90BF     CD E7 92              CALL    TSTR     ;SEE IF WE NEED TO INTERCHANGE
                                                ;BPTR AND LPTR
90C2     CA AD 91              JZ      NORM     ;NO INTERCHANGE NECESSARY, SO NORMALIZE
                                                ;AND RETURN
90C5     7D                    MOV A,L        ;INTERCHANGE
90C6     68                    MOV L,B        ;L
90C7     47                    MOV B,A        ;AND B
```

```
90C8    79                  MOV A,C               ;CPTR  TO A
90C9    48                  MOV C,B               ;BPTR TO C
90CA    5D                  MOV E,L               ;LPTR TO E
90CB    47                  MOV B,A               ;CPTR TO B
90CC    CD 24 93            CALL LXFR             ;MOVE BPTR> TO  LPTR>
90CF    78                  MOV A,B
90D0    41                  MOV B,C
90D1    4F                  MOV C,A
90D2    6B                  MOV L,E
90D3    C3 AD 91            JMP      NORM           ;NORMALIZE RESULT AND RETURN
                    ;
                    ;   COPY THE LARGER CHARACTERISTIC TO THE RESULT
                    ;
90D6    CD 5B 92    ADDZ:   CALL     CCMP           ;COMPARE THE CHARACTERISTICS
90D9    D2 DF 90            JNC      ADD2           ;IF CHAR(H,L) .GE. CHAR(H,B) CONTINUE
90DC    CD 8D 93            CALL     BCTL           ;IF CHAR(H,L) .LT. CHAR(H,B) THE COPY
                                                    ;CHAR(H,B) TO CHAR(H,L)
90DF    CD EF 90    ADD2:   CALL     MANT           ;COMPUTE SIGN OF RESULT
90E2    CD 06 92            CALL     DADD           ;ADD MANTISSAS
90E5    D2 D2 92             JNC     SCCFG               ;IF THERE IS NO OVFLW - DONE
90E8    CD F8 91            CALL     DRST           ;IF OVERFLOW SHIFT RIGHT
90EB    CD B6 92            CALL     INCR           ;AND INCREMENT CHARACTERISTIC
90EE    C9                  RET                     ;ALL DONE, SO RETURN
                    ;
                    ;   THIS ROUTINE STORES THE MANTISSA SIGN IN THE RESULT
                    ;   THE SIGN HAS PREVIOUSLY BEEN COMPUTED BY LASD.
                    ;
90EF    5D           MANT:  MOV E,L               ;SAVE L PTR
90F0    69                  MOV L,C               ;C PTR TO L
90F1    7E                  MOV A,M               ;LOAD INDEX WORD
90F2    E6 80               ANI 128               ;SCARF SIGN
90F4    6B                  MOV L,E               ;RESTORE L PTR
90F5    2C                  INR L                 ;L PTR 2
90F6    2C                  INR L
90F7    2C                  INR L                 ;TO L
90F8    5F                  MOV E,A               ;SAVE SIGN IN E
90F9    7E                  MOV A,M
90FA    E6 7F               ANI 127               ;SCARF CHAR
90FC    83                  ADD E                 ;ADD SIGN
90FD    77                  MOV M,A               ;STORE IT
90FE    2D                  DCR L                 ;RESTORE
```

```
90FF      2D                          DCR L
9100      2D                          DCR L             ;L PTR
9101      C9                          RET
                          ;
                          ;
                           ;                            SUBROUTINE LASD
                           ;                            UTILITY ROUTINE FOR LADS
                           ;                            CALCULATES TRUE OPER AND SGN
                           ;                            RETURNS ANSWER IN
9102      CD 79 93         LASD:      CALL MSFH           ;FETCH MANT SIGNS, F IN A,D
9105      BB                          CMP E               ;COMPARE SIGNS
9106      DA 34 91                    JC   ABCH           ;F ,S- MEANS GO TO A BRANCH
9109      C2 3D 91                    JNZ BBCH            ;F- S  MEANS GO TO B BRANCH
910C      83                          ADD E               ;SAME SIGN IF HERE, ADD SIGNS
910D      DA 22 91                    JC   BMIN           ;IF BOTH MINUS, WILL OVERFLOW
9110      CD E1 92                    CALL AORS           ;BOTH POS IF HERE
9113      F2 46 91                    JP   L000           ;IF AN ADD, LOAD 0
9116      CD F4 92         COM1:      CALL DCMP           ;COMPARE F WITH S
9119      DA 54 91                    JC   L131           ;S.GT.F,SO LOAD 131
911C      C2 48 91                    JNZ L001            ;F.GT.S,SO LOAD 1
911F      3E 02            L002:      MVI  A,2            ;ERROR CONDITION, ZERO ANSWER
9121      C9                          RET
9122      CD E1 92         BMIN:      CALL AORS           ;CHECK FOR ADD OR SUB
9125      F2 4E 91                    JP   L128           ;ADD, SO LOAD 128
9128      CD F4 92         COM2:      CALL DCMP           ;COMPARE F WITH S
912B      DA 4B 91                    JC   L003           ;S.GT.F,SO LOAD 3
912E      C2 51 91                    JNZ L129            ;FGT.S.SO LOAD 129
9131      C3 1F 91                    JMP L002            ;ERROR
9134      CD E1 92         ABCH:      CALL AORS           ;FT,S- SO TEST FOR A/S
9137      FA 46 91                    JM   L000           ;SUBTRACT, SO LOAD 0
913A      C3 16 91                    JMP COM1            ;ADD, SO GO TO DCMP
913D      CD E1 92         BBCH:      CALL AORS           ;F-,S ,SO TEST FOR A/S
9140      FA 4E 91                    JM   L128           ;SUB
9143      C3 28 91                    JMP COM2            ;ADD
9146      AF               L000:      XRA  A
9147      C9                          RET
9148      3E 01            L001:      MVI  A,1
914A      C9                          RET
914B      3E 03            L003:      MVI  A,3
914D      C9                          RET
914E      3E 80            L128:      MVI  A,128
```

```
9150    C9                    RET
9151    3E 81         L129:   MVI  A,129
9153    C9                    RET
9154    3E 83         L131:   MVI  A,131
9156    C9                    RET
                      ;
                      ;                        SUBROUTINE LMCM
                      ;                        COMPARES THE MAGNITUDE OF
                      ;                        TWO FLOATING PNT NUMBERS
                      ;                        Z 1 IF  ,C 1 IF F.LT.S.
9157    CD 5B 92      LMCM:   CALL CCMP          ;CHECK CHARS
915A    C0                    RNZ                ;RETURN IF NOT EQUAL
915B    CD F4 92              CALL DCMP          ;IF EQUAL, CHECK MANTS
915E    C9                    RET
                      ;
                      ;
                      ;
                      ;**************************************************
                      ;       //// MULTIPLY SUBROUTINE
                      ;**************************************************
                      ;
                      ;                        SUBROUTINE LMUL
                      ;                        FLOATING POINT MULTIPLY
                      ;                        L PTR X B PTR TO C PTR
                      ;
915F    CD 69 93      LMUL:   CALL    CSIGN         ;COMPUTE SIGN OF RESULT AND STORE IT
9162    CD DA 91              CALL    ZCHK          ;CHECK FIRST OPERAND FOR ZERO
9165    CA AF 92              JZ      WZERC         ;ZERO * ANYTHING = ZERO
9168    CD E2 91              CALL    BCHK          ;CHECK SECOND OPERAND FOR ZERO
916B    CA AF 92              JZ      WZERC         ;ANYTHING * ZERO = ZERO
916E    5D                    MOV E,L            ;SAVE L PTR
916F    69                    MOV L,C            ;C PTR TO L
9170    CD 1D 92              CALL DCLR          ;CLR PRODUCT MANT LOCS
9173    6B                    MOV L,E            ;L PTR TO L
9174    16 18                 MVI D,24           ;LOAD NUMBER ITERATIONS
9176    CD F8 91       KPGO:  CALL DRST          ;SHIFT L PTR RIGHT
9179    DA A4 91              JC  MADD           ;WILL ADD B PTR IF C 1
917C    7D                    MOV A,L            ;INTERCHANGE
917D    69                    MOV L,C            ;L AND
917E    4F                    MOV C,A            ;C PTRS
917F    CD F8 91       INTR:  CALL DRST          ;SHIFT PRODUCT OVER
```

```
9182   7D               MOV A,L           ;INTERCHANGE
9183   69               MOV L,C           ;L AND C PTRS BACK TO
9184   4F               MOV C,A           ;ORIGINAL>
9185   15               DCR D
9186   C2 76 91         JNZ KPGO          ;MORE CYCLES IF Z 0
9189   CD E1 92         CALL    AORS        ;TEST IF RESULT IS NORMALIZED
918C   FA 40 93         JM      LMCP        ;IF NORMALIZED GO COMPUTE CHAR
918F   5D               MOV     E,L         ;SAVE LPTR IN E
9190   69               MOV     L,C         ;SET L=CPTR
9191   CD E9 91         CALL    DLST        ;LEFT SHIFT RESULT TO NORMALIZE
9194   6B               MOV     L,E         ;RESTORE LPTR
9195   CD 4C 92         CALL    CFCHE       ;OTHERWISE SET A=CHAR(H,L), E=CHAR(H,B)
9198   83               ADD     E           ;CHAR(RESULT) = CHAR(H,L) + CHAR(H,B)
9199   FE 80            CPI     200Q        ;CHECK FOR SMALLEST NEGATIVE NUMBER
919B   CA 62 93         JZ      UFLWC       ;IF SO THEN UNDERFLOW
919E   D6 01            SUI     1           ;SUBTRACT 1 TO COMPENSATE FOR NORMALIZE
91A0   CD 44 93         CALL    CCHK        ;CHECK CHARACTERISTIC AND STORE IT
91A3   C9               RET                 ;RETURN
                 ;
91A4   7D        MADD:  MOV A,L           ;INTERCHANGE
91A5   69               MOV L,C           ;L AND
91A6   4F               MOV C,A           ;C PTRS
91A7   CD 06 92         CALL DADD         ;ACCUMULATE PRODUCT
91AA   C3 7F 91         JMP INTR
                 ;
                 ;   SUBROUTINE NORM
                 ;
                 ;       THIS SUBROUTINE WILL NORMALIZE A FLOATING POINT
                 ;       NUMBER, PRESERVING ITS ORIGINAL SIGN.
                 ;       WE CHECK FOR UNDERFLOW AND SET THE CONDITION
                 ;       FLAG APPROPRIATELY.  (SEE ERROR RETURNS).
                 ;       THER IS AN ENTRY POINT TO FLOAT A SIGNED INTEGER
                 ;       (FLOAT) AND AN ENTRY POINT TO FLOAT AN UNSIGNED
                 ;       INTEGER.
                 ;
                 ;   ENTRY POINTS:
                 ;
                 ;       NORM  - NORMALIZE FLOATING PT NUMBER AT (H,L)
                 ;       FLOAT - FLOAT TRIPLE PRECISION INTEGER AT (H,L)
                 ;               PRESERVING SIGN BIT IN (H,L)+3
                 ;       DFXL  - FLOAT UNSIGNED (POSITIVE) TRIPLE PRECISION
```

```
                        ;                  AT (H,L)
                        ;
                        ;REGISTERS ON EXIT:
                        ;
                        ;          A = CONDITION FLAG (SEE ERROR RETURNS)
                        ;          D,E = GARBAGE
                        ;          B,C,H,L = SAME AS ON ENTRY
                        ;
91AD    5D              NORM:     MOV     E,L         ;SAVE L IN E
91AE    CD 41 92        NORM1:    CALL    GCHAR       ;GET CHAR(H,L) IN A WITH SIGN EXTENDED
91B1    57                        MOV     D,A         ;SAVE CHAR IN D
91B2    6B              FXL1:     MOV     L,E         ;RESTORE L
91B3    CD DA 91        FXL2:     CALL    ZMCHK       ;CHECK FOR ZERO MANTISSA
91B6    CA 8D 92                  JZ      WZER        ;IF ZERO MANTISSA THEN ZERO RESULT
91B9    7E              REP6:     MOV     A,M         ;GET MOST SIGNIFICANT BYTE OF
                                                      ;MANTISSA
91BA    B7                        ORA     A           ;SET FLAGS
91BB    FA CB 91                  JM      SCHAR       ;IF MOST SIGNFICANT BIT = 1 THEN
                                                      ;NUMBER IS NORMALIZED AND WE GO TO
                                                      ;STORE THE CHARACTERISTIC
91BE    7A                        MOV     A,D         ;OTHERWISE CHECK FOR UNDERFLOW
91BF    FE C0                     CPI     MINCH       ;COMPARE WITH MINIMUM CHAR
91C1    CA 63 92                  JZ      WUND        ;IF EQUAL THEN UNDERFLOW
91C4    CD E9 91                  CALL    DLST        ;SHIFT MANTISSA LEFT
91C7    15                        DCR     D           ;DECREMENT CHARACTERSTIC
91C8    C3 B9 91                  JMP     REP6        ;LOOP AN TEST NEXT BIT
91CB    C3 C3 92        SCHAR:    JMP     INCR3       ;STORE THE CHARACTERISTIC USING
                                                      ;THE SAME CODE AS THE INCREMENT
                        ;
91CE    5D              DFXL:     MOV     E,L         ;ENTER HERE TO FLOAT UNSIGNED
                                                      ;INTEGER
                                                      ;FIRT SAVE L IN E
91CF    2C                        INR     L           ;MAKE (H,L) POINT TO CHAR
91D0    2C                        INR     L           ;MAKE (H,L) POINT TO CHAR
91D1    2C                        INR     L           ;MAKE (H,L) POINT TO CHAR
91D2    AF                        XRA     A           ;ZERO ACCUMULATOR
91D3    77                        MOV     M,A         ;STORE A PLUS (+) SIGN
91D4    6B                        MOV     L,E         ;RESTORE L
91D5    16 18           FLOAT:    MVI     D,24        ;ENTER HERE TO FLOAT INTEGER
                                                      ;PRESERVING ORIGINAL SIGN IN (H,L)+3
                                                      ;SET UP CHARACTERISTIC
91D7    C3 B3 91                  JMP     FXL2        ;GO FLOAT THE NUMBER
```

```
                          ;
                          ;
                          ;
                          ;   SUBROUTINE ZCHK
                          ;
                          ;       THIS ROUTINE SETS THE ZERO FLAG IF IT DETECTS
                          ;       A FLOATING ZERO AT (H,L).
                          ;
                          ;   SUBROUTINE ZMCHK
                          ;
                          ;       THIS ROUTINE SETS THE ZERO FLAG IF IT DETECTS A
                          ;       ZERO MANTISSA AT (H,L)
                          ;
91DA                      ZCHK:
91DA    2C                ZMCHK:  INR     L           ;SET L TO POINT LAST BYTE OF MANTISSA
91DB    2C                        INR     L           ;SET L TO POINT TO LAST BYTE OF MANTISSA
91DC    7E                        MOV     A,M         ;LOAD LEAST SIGNIFICANT BYTE
91DD    2D                        DCR     L           ;L POINTS TO MIDDLE BYTE
91DE    B6                        ORA     M           ;OR WITH LEAST SIGNFICANT BYTE
91DF    2D                        DCR     L           ;L POINTS TO MOST SIGNFICANT BYTE
                                                      ;OF MANTISSA (ORIGINAL VALUE)
91E0    B6                        ORA     M           ;OR IN MOST SIGNFICANT BYTE
91E1    C9                        RET                 ;RETURNS WITH ZERO FLAG SET APPROPRIATELY
                          ;
                          ;  SUBROUTINE BCHK
                          ;
                          ;       THIS ROUTINE CHECKS (H,B) FOR FLOATING PT ZERO
                          ;
91E2    5D                BCHK:   MOV     E,L         ;SAVE LPTR IN E
91E3    68                        MOV     L,B         ;SET L=BPTR
91E4    CD DA 91                  CALL    ZCHK        ;CHECK FOR ZERO
91E7    6B                        MOV     L,E         ;RESTORE L=LPTR
91E8    C9                        RET                 ;RETURN
                          ;
                          ;
                          ;                     SUBROUTINE DLST
                           ;                    SHIFTS DBL WORD ONE PLACE LF
91E9    2C                 DLST:  INR L
91EA    2C                        INR L             ;/***TP
91EB    7E                        MOV A,M           ;LOAD IT
```

```
91EC    B7                   ORA A          ;KILL CARRY
91ED    17                   RAL            ;SHIFT IT LEFT
91EE    77                   MOV M,A        ;STORE IT
91EF    2D                   DCR L
91F0    7E                   MOV A,M        ;LOAD IT
91F1    17                   RAL            ;SHIFT IT LEFT
                   ;                       IF CARRY SET BY FIRST SHIFT
                   ;                       IT WILL BE IN LSB OF SECOND
91F2    77                   MOV M,A
91F3    2D                   DCR L          ;/***TP EXTENSION
91F4    7E                   MOV A,M
91F5    17                   RAL
91F6    77                   MOV M,A        ;/***ALL DONE TP
91F7    C9                   RET
                   ;                       SUBROUTINE DRST
                   ;                       SHIFTS DOUBLE WORD ONE PLACE
                   ;                       TO THE RIGHT
                   ;                       DOES NOT AFFECT D
91F8    5D         DRST:     MOV E,L        ;/***TP MODIFIED RIGHT SHIFT TP
91F9    7E                   MOV A,M        ;LOAD FIRST WORD
91FA    1F                   RAR            ;ROTATE IT RIGHT
91FB    77                   MOV M,A        ;STORE IT
91FC    2C                   INR L          ;/*** TP
91FD    7E                   MOV A,M        ;LOAD SECOND WORD
91FE    1F                   RAR            ;SHIFT IT RIGHT
91FF    77                   MOV M,A        ;STORE IT
9200    2C                   INR L          ;/*** TP EXTENSION
9201    7E                   MOV A,M
9202    1F                   RAR
9203    77                   MOV M,A
9204    6B                   MOV L,E        ;/***TP - ALL DONE TP
9205    C9                   RET
                   ;                       SUBROUTINE DADD
                   ;                       ADDS TWO DOUBLE PRECISION
                   ;                       WORDS, C 1 IF THERE IS OVRFLW
9206    5D         DADD:     MOV E,L        ;SAVE BASE IN E
9207    68                   MOV L,B        ;BASE  3 TO L
9208    2C                   INR L          ;BASE  4 TO L
9209    2C                   INR L          ;/***TP
920A    7E                   MOV A,M        ;LOAD S MANTB
920B    6B                   MOV L,E        ;BASE TO L
```

```
920C    2C                 INR L          ;BASE  1 TO L
920D    2C                 INR L          ;/***TP
920E    86                 ADD M          ;ADD TWO MANTB S
920F    77                 MOV M,A        ;STORE ANSWER
9210    68                 MOV L,B        ;/***TP EXTENSION
9211    2C                 INR L
9212    7E                 MOV A,M
9213    6B                 MOV L,E
9214    2C                 INR L
9215    8E                 ADC M
9216    77                 MOV M,A         ;/***TP - ALL DONE
9217    68                 MOV L,B         ;BASE  3 TO L
9218    7E                 MOV A,M         ;MANTA OF S TO A
9219    6B                 MOV L,E         ;BASE TO L
921A    8E                 ADC M           ;ADD WITH CARRY
921B    77                 MOV M,A         ;STORE ANSWER
921C    C9                 RET
                 ;                       SUBROUTINE DCLR
                 ;                       CLEARS TWO SUCCESSIVE
                 ;                       LOCATIONS OF MEMORY
921D    AF       DCLR:     XRA A
921E    77                 MOV M,A
921F    2C                 INR L
9220    77                 MOV M,A
9221    2C                 INR L            ;/***TP EXTENSION
9222    77                 MOV M,A          ;/***TP ZERO 3
9223    2D                 DCR L            ;/***TP - ALL DONE
9224    2D                 DCR L
9225    C9                 RET
                 ;                       /*****ALL NEW DSUB - SHORTER***
                 ;                       SUBROUTINE DSUB
                 ;                       DOUBLE PRECISION SUBTRACT
9226    5D       DSUB:     MOV E,L          ;SAVE BASE IN E
9227    2C                 INR L            ;/***TP EXTENSION
9228    2C                 INR L            ;/START WITH LOWS
9229    7E                 MOV A,M          ;/GET ARG
922A    68                 MOV L,B          ;/NOW SET UP TO SUB
922B    2C                 INR L
922C    2C                 INR L
922D    96                 SUB M            ;/NOW DO IT
922E    6B                 MOV L,E          ;/NOW MUST PUT IT BACK
```

```
922F    2C            INR L
9230    2C            INR L
9231    77            MOV M,A          ;/PUT BACK
9232    2D            DCR L            ;/***TP - ALL DONE
9233    7E            MOV A,M          ;/GET LOW OF LOP
9234    68            MOV L,B          ;/SET TO BOP
9235    2C            INR L            ;/SET TO BOP LOW
9236    9E            SBB M            ;/GET DIFF. OF LOWS
9237    6B            MOV L,E          ;/SAVE IN LOP LOW
9238    2C            INR L            ;/TO LOP LOW
9239    77            MOV M,A          ;/INTO RAM
923A    2D            DCR L            ;/BACK UP TO LOP HIGH
923B    7E            MOV A,M          ;/GET LOP HIGH
923C    68            MOV L,B          ;/SET TO BOP HIGH
923D    9E            SBB M            ;/SUB. WITH CARRY
923E    6B            MOV L,E          ;/SAVE IN LOP HIGH
923F    77            MOV M,A          ;/INTO RAM
9240    C9            RET              ;/ALL DONE - MUCH SHORTER
                  ;
                  ;   SUBROUTINE GCHAR
                  ;
                  ;      THIS SUBROUTINE RETURNS THE CHARACTERISTIC OF
                  ;      THE FLOATING POINT NUMBER POINTED TO BY (H,L)
                  ;      IN THE A REGISTER WITH ITS SIGN EXTENDED INTO THE
                  ;      LEFTMOST BIT.
                  ;
                  ;   REGISTERS ON EXIT:
                  ;
                  ;      A = CHARACTERISTIC OF (H,L) WITH SIGN EXTENDED
                  ;      L = (ORIGINAL L) + 3
                  ;      B,C,D,E,H = SAME AS ON ENTRY
                  ;
9241    2C        GCHAR:  INR     L         ;MAKE (H,L) POINT TO CHAR
9242    2C                INR     L         ;MAKE (H,L) POINT TO CHAR
9243    2C                INR     L         ;MAKE (H,L) POINT TO CHAR
9244    7E                MOV     A,M       ;SET A=CHAR + MANTISSA SIGN
9245    E6 7F             ANI     177Q      ;GET RID OF MANTISSA SIGN BIT
9247    C6 40             ADI     100Q      ;PROPAGATE CHAR SIGN INTO LEFTMOST BIT
9249    EE 40             XRI     100Q      ;RESTORE ORIGINAL CHAR SIGN BIT
924B    C9                RET               ;RETURN WITH (H,L) POINTING TO THE
                                            ;CHAR = ORIGINAL (H,L)+3
                                            ;SOMEONE ELSE WILL CLEAN UP
```

```
                          ;
                          ;    SUBROUTINE CFCHE
                          ;
                          ;        THIS SUBROUTINE RETURNS THE CHARACTERISTICS OF THE
                          ;        FLOATING POINT NUMBERS POINTED TO BY (H,L) AND
                          ;        (H,B) IN THE A AND E REGISTERS RESPECTIVELY,
                          ;        WITH THEIR SIGNS EXTENDED INTO THE LEFTMOST BIT.
                          ;
                          ;    REGISTERS ON EXIT:
                          ;
                          ;        A = CHARACTERISTIC OF (H,L) WITH SIGN EXTENDED
                          ;        E = CHARACTERISTIC OF (H,B) WITH SIGN EXTENDED
                          ;        B,C,H,L = SAME AS ON ENTRY
                          ;        D = A
                          ;
924C    5D                CFCHE:  MOV     E,L         ;SAVE LPTR IN E
924D    68                        MOV     L,B         ;SET L = BPTR
924E    CD 41 92                  CALL    GCHAR       ;GET CHAR(H,B) WITH SIGN EXTENDED IN A
9251    6B                        MOV     L,E         ;RESTORE L = LPTR
9252    5F                        MOV     E,A         ;SET E=CHAR(H,B) WITH SIGN EXTENDED
9253    CD 41 92                  CALL    GCHAR       ;SET A=CHAR(H,L) WITH SIGN EXTENDED
9256    2D                        DCR     L           ;RESTORE L = LPTR
9257    2D                        DCR     L           ;RESTORE L = LPTR
9258    2D                        DCR     L           ;RESTORE L = LPTR
9259    57                        MOV     D,A         ;SET D=A=CHAR(H,L) WITH SIGN EXTENDED
925A    C9                        RET
                          ;
                          ;
                          ;    SUBROUTINE CCMP
                          ;
                          ;        THIS SUBROUTINE COMPARES THE CHARACTERISTICS OF
                          ;        FLOATING POINT NUMBERS POINTED TO BY (H,L) AND (H,B).
                          ;        THE ZERO FLIP-FLOP IS SET IF CHAR(H,L) EQUALS
                          ;        CHAR(H,B).  IF CHAR(H,L) IS LESS THAN CHAR(H,B) THEN
                          ;        THE CARRY BIT WILL BE SET.
                          ;
                          ;    REGISTERS ON EXIT:
                          ;
                          ;        A = CHARACTERISTIC OF (H,L) WITH SIGN EXTENDED
                          ;        E = CHARACTERISTIC OF (H,B) WITH SIGN EXTENDED
                          ;        D = A
                          ;       B,C,H,L = SAME AS ON ENTRY
                          ;
925B      CD 4C 92        CCMP:    CALL    CFCHE       ;FETCH CHARACTERTISTICS WITH SIGN
                                                       ;EXTENDED INTO A (CHAR(H,L)) AND E
925E      57                       MOV     D,A         ;(CHAR(H,B)) REGIS SAVE CHAR (H,L)
925F      93                       SUB     E           ;SUBTRACT E (CHAR(H,B))
9260      17                       RAL                 ;ROTATE SIGN BIT INTO CARRY BIT
9261      7A                       MOV     A,D         ;RESTORE A=CHAR(H,L)
9262      C9                       RET                 ;RETURN
                          ;
                          ;    ERROR RETURNS
                          ;
                          ;       THE FOLLOWING CODE IS USED TO RETURN VARIOUS
                          ;       ERROR CONDITIONS.  IN EACH CASE A FLOATING POINT
                          ;       NUMBER IS STORED IN  THE 4 WORDS POINTED TO BY (H,L)
                          ;       AND A FLAG IS STORED IN THE ACCUMULATOR.
                          ;
                          ;       CONDITION   FLAG   RESULT (+)         RESULT (-)
                          ;
                          ;       UNDERFLOW    377   000 000 000 100    000 000 000 300
                          ;       OVERFLOW     177   377 377 377 077    377 377 377 277
                          ;       INDEFINITE   077   377 377 377 077    377 377 377 277
                          ;       NORMAL       000   XXX XXX XXX XXX    XXX XXX XXX XXX
                          ;       NORMAL ZERO  000   000 000 000 100    (ALWAYS RETURNS +0)
                          ;
                          ;    ENTRY POINTS:
                          ;
                          ;       WUND - WRITE UNDERFLOW
                          ;       WOVR - WRITE OVERFLOW
                          ;       WIND - WRITE INDEFINITE
                          ;       WZER - WRITE NORMAL ZERO
                          ;
              1           WFLT     MACRO   VMANT,VCHAR,VFLAG,LABEL  ;WRITE FLOATING NUMBER
              1
              1                    MVI     D,VCHAR     ;LOAD CHARACTERISTIC INTO D REGISTER
              1                    CALL    WCHAR       ;WRITE CHARACTERISTIC
              1           LABEL::  MVI     A,VMANT     ;LOAD MANTISSA VALUE
              1                                        ;WE ASSUME HERE THAT ALL BYTES OF
              1                                        ;MANTISSA ARE THE SAME
              1                    CALL    WMANT       ;WRITE THE MANTISSA
              1                    MVI     A,VFLAG     ;SET ACCUMULATOR TO FLAG
```

```
                 1                          ORA     A              ;SET FLAGS PROPERLY
                 1                          RET                    ;RETURN (WMANT RESTORED (H,L))
                                            ENDM
                                ;
         9263    1                         +WUND:    WFLT    0,100Q,377Q,UFLW1  ;WRITE UNDERFLOW
                 1                          +
         9263    1  16 40                   +        MVI     D,00040H       ;LOAD CHARACTERISTIC INTO D REGISTER
         9265    1  CD 9F 92                +        CALL    WCHAR          ;WRITE CHARACTERISTIC
         9268    1  3E 00                   +UFLW1::  MVI     A,00000H       ;LOAD MANTISSA VALUE
                 1                          +                               ;WE ASSUME HERE THAT ALL BYTES OF
                 1                          +                               ;MANTISSA ARE THE SAME
         926A    1  CD 98 92                +        CALL    WMANT          ;WRITE THE MANTISSA
         926D    1  3E FF                   +        MVI     A,000FFH       ;SET ACCUMULATOR TO FLAG
         926F    1  B7                      +        ORA     A              ;SET FLAGS PROPERLY
         9270    1  C9                      +        RET                    ;RETURN (WMANT RESTORED (H,L))
         9271    1                          +WOVR:    WFLT    377Q,77Q,177Q,OFLW1  ;WRITE OVERFLOW
                 1                          +
         9271    1  16 3F                   +        MVI     D,0003FH       ;LOAD CHARACTERISTIC INTO D REGISTER
         9273    1  CD 9F 92                +        CALL    WCHAR          ;WRITE CHARACTERISTIC
         9276    1  3E FF                   +OFLW1::  MVI     A,000FFH       ;LOAD MANTISSA VALUE
                 1                          +                               ;WE ASSUME HERE THAT ALL BYTES OF
                 1                          +                               ;MANTISSA ARE THE SAME
         9278    1  CD 98 92                +        CALL    WMANT          ;WRITE THE MANTISSA
         927B    1  3E 7F                   +        MVI     A,0007FH       ;SET ACCUMULATOR TO FLAG
         927D    1  B7                      +        ORA     A              ;SET FLAGS PROPERLY
         927E    1  C9                      +        RET                    ;RETURN (WMANT RESTORED (H,L))
         927F    1                          +WIND:    WFLT    377Q,77Q,77Q,INDF1  ;WRITE INDEFINITE
                 1                          +
         927F    1  16 3F                   +        MVI     D,0003FH       ;LOAD CHARACTERISTIC INTO D REGISTER
         9281    1  CD 9F 92                +        CALL    WCHAR          ;WRITE CHARACTERISTIC
         9284    1  3E FF                   +INDF1::  MVI     A,000FFH       ;LOAD MANTISSA VALUE
                 1                          +                               ;WE ASSUME HERE THAT ALL BYTES OF
                 1                          +                               ;MANTISSA ARE THE SAME
         9286    1  CD 98 92                +        CALL    WMANT          ;WRITE THE MANTISSA
         9289    1  3E 3F                   +        MVI     A,0003FH       ;SET ACCUMULATOR TO FLAG
         928B    1  B7                      +        ORA     A              ;SET FLAGS PROPERLY
         928C    1  C9                      +        RET                    ;RETURN (WMANT RESTORED (H,L))
                                ;
         928D       2C                       WZER:    INR     L              ;WRITE NORMAL ZERO
         928E       2C                                INR     L              ;
         928F       2C                                INR     L              ;
```

```
9290    36 40                 MVI     M,100Q      ;STORE CHARACTERISTIC FOR ZERO
9292    AF                    XRA     A           ;ZERO ACCUMULATOR
9293    CD 98 92              CALL    WMANT       ;STORE ZERO MANTISSA
9296    B7                    ORA     A           ;SET FLAGS PROPERLY
9297    C9                    RET                 ;RETURN
                      ;
                      ; ROUTINE TO WRITE MANTISSA FOR ERROR RETURNS
                      ;
9298    2D            WMANT:  DCR     L           ;POINT LEAST SIGNIFICANT BYTE
                                                  ;OF MANTISSA
9299    77                    MOV     M,A         ;STORE LSBYTE OF MANTISSA
929A    2D                    DCR     L           ;POINT TO NEXT LEAST SIGNIFICANT BYTE
                                                  ;OF MANTISSA
929B    77                    MOV     M,A         ;STORE NLSBYTE OF MANTISSA
929C    2D                    DCR     L           ;POINT TO MOST SIGNIFICANT BYTE
                                                  ;OF MANTISSA
929D    77                    MOV     M,A         ;STORE MSBYTE OF MANTISSA
929E    C9                    RET                 ;RETURN (H,L) POINTS TO BEGINNING OF
                                                  ;FLOATING POINT RESULT
                      ;
                      ; ROUTINE TO WRITE CHARACTERTIC FOR ERROR RETURNS
                      ; NOTE:  WE PRESERVE ORIGINAL MANTISSA SIGN
                      ; ON ENTRY D CONTAINS NEW CHARACTERTISTIC TO BE STORED.
                      ;
929F    2C            WCHAR:  INR     L           ;SET (H,L) TO POINT TO CHARACTERISTIC
92A0    2C                    INR     L           ;PART OF ABOVE
92A1    2C                    INR     L           ;PART OF ABOVE
92A2    7E                    MOV     A,M         ;LOAD CHARACTERISTIC A
                                                  ;AND MANTISSA SIGN
92A3    E6 80                 ANI     200Q        ;JUST KEEP MANTISSA SIGN
92A5    B2                    ORA     D           ;OR IN NEW CHARACTERISTIC
92A6    77                    MOV     M,A         ;STORE IT BACK
92A7    C9                    RET                 ;RETURN WITH (H,L) POINT TO
                                                  ;CHARACTERISTIC OF RESULT
                                                  ;SOMEONE ELSE WILL FIX UP (H,L)
                      ;
                      ;   SUBROUTINE INDFC
                      ;
                      ;       THIS ROUTINE WRITES A FLOATING INDEFINITE, SETS
                      ;       THIS WRITES WRITES A FLOATING POINT INDEFINITE
                      ;       AT (H,C), SETS THE CONDITION FLAG AND RETURNS
                      ;
```

```
                           ;
92A8    5D                 INDFC:  MOV     E,L          ;SAVE LPTR IN E
92A9    69                         MOV     L,C          ;SET L=CPTR SO (H,L)-ADDR OF RESULT
92AA    CD 7F 92                   CALL    WIND         ;WRITE INDEFINITE
92AD    6B                         MOV     L,E          ;RESTORE L=LPTR
92AE    C9                         RET                  ;RETURN
                           ;
                           ;
                           ;     SUBROUTINE WZERC
                           ;
                           ;        THIS ROUTINE WRITES A NORMAL FLAOTING POINT ZERO
                           ;        AT (H,C), SETS THE CONDITION FLAG AND RETURNS
                           ;
92AF    5D                 WZERC:  MOV     E,L          ;SAVE LPTR IN E
92B0    69                         MOV     L,C          ;SETL=CPTR SO (H,L)=ADDR OF RESULT
92B1    CD 8D 92                   CALL    WZER         ;WRITE NORMAL ZERO
92B4    6B                         MOV     L,E          ;RESTORE L=LPTR
92B5    C9                         RET                  ;RETURN
                           ;
                           ;     SUBROUTINE INCR
                           ;
                           ;        THIS SUBROUTINE INCREMENTS THE CHARACTERISTIC
                           ;        OF THE FLOATING POINT NUMBER POINTED TO BY (H,L).
                           ;        WE TEST FOR OVERFLOW AND SET APPROPRIATE FLAG.
                           ;        (SEE ERRROR RETURNS).
                           ;
                           ;     REGISTERS ON EXIT:
                           ;
                           ;        A = CONDITION FLAG (SEE ERROR RETURNS)
                           ;        D = CLOBBERED
                           ;        B,C,H,L = SAME AS ON ENTRY
                           ;
92B6    CD 41 92           INCR:   CALL    GCHAR        ;GET CHAR WITH SIGN EXTENDED
92B9    FE 3F                      CPI     MAXCH        ;COMPARE WITH MAX CHAR PERMITTED
92BB    CA 76 92                   JZ      OFLW1        ;INCREMENT WOULD CAUSE OVERFLOW
92BE    57                         MOV D,A            ;/SAVE IT IN D
92BF    14                         INR D              ;/INCREMENT IT
92C0    C3 C6 92                   JMP     INCR2        ;JUMP AROUND ALTERNATE ENTRY POINT
92C3    2C                 INCR3:  INR     L            ;COME HERE TO STORE CHARACTERISTIC
92C4    2C                         INR     L            ;POINT (H,L) TO CHAR
92C5    2C                         INR     L            ;POINT (H,L) TO CHAR
```

```
92C6    3E 7F       INCR2:  MVI A,177Q
92C8    A2                  ANA D               ;/KILL SIGN BIT
92C9    57                  MOV D,A             ;/BACK TO D
92CA    7E                  MOV A,M             ;/NOW SIGN IT
92CB    E6 80               ANI 200Q            ;/GET MANTISSA SIGN
92CD    B2                  ORA D               ;/PUT TOGETHER
92CE    77                  MOV M,A             ;/STORE IT BACK
92CF    2D                  DCR L               ;/NOW BACK TO BASE
92D0    2D                  DCR L               ;/***TP
92D1    2D                  DCR L
92D2    AF          SCCFG:   XRA    A                   ;SET SUCCESS FLAG
92D3    C9                  RET
                    ;
                    ;   SUBROUTINE DECR
                    ;
                    ;       THIS SUBROUTINE DECREMENTS THE CHARACTERISTIC
                    ;       OF THE FLOATING POINT NUMBER POINTED TO BY (H,L).
                    ;       WE TEST FOR UNDERFLOW AND SET APPROPRIATE FLAG.
                    ;       (SEE ERRROR RETURNS).
                    ;
                    ;   REGISTERS ON EXIT:
                    ;
                    ;       A = CONDITION FLAG (SEE ERROR RETURNS)
                    ;       D = CLOBBERED
                    ;       B,C,H,L = SAME AS ON ENTRY
                    ;
92D4    CD 41 92    DECR:   CALL    GCHAR       ;GET CHAR WITH SIGN EXTENDED
92D7    FE CO               CPI     MINCH       ;COMPARE WITH MIN CHAR PERMITTED
92D9    CA 68 92            JZ      UFLW1       ;DECREMENT WOULD CAUSE UNDERFLOW
92DC    57                  MOV     D,A         ;SAVE CHARACTERSTIC IN D
92DD    15                  DCR     D           ;DECREMENT CHARACTERISTIC
92DE    C3 C6 92            JMP     INCR2       ;GO STORE IT BACK
                    ;
                     ;                      SUBROUTINE AORS
                     ;                      RETURN S 1 IF BASE  6
                     ;                      HAS A 1 IN MSB
92E1    5D           AORS:  MOV E,L             ;SAVE BASE
92E2    69                  MOV L,C             ;BASE  6 TO L
92E3    7E                  MOV A,M             ;LOAD IT
92E4    B7                  ORA A               ;SET FLAGS
92E5    6B                  MOV L,E             ;RESTORE BASE
```

```
92E6    C9                  RET
                    ;                   SUBROUTINE TSTR
                    ;                   CHECKS C PTR TO SEE IF
                    ;                   NLSB 1
                    ;                   RETURNS Z 1 IF NOT
                    ;                   DESTROYS E,D
92E7    5D          TSTR:   MOV  E,L        ;SAVE BASE
92E8    69                  MOV  L,C        ;C PTR TO L
92E9    16 02               MVI  D,2        ;MASK TO D
92EB    7E                  MOV  A,M        ;LOAD VALUE
92EC    6B                  MOV  L,E        ;RESTORE BASE
92ED    A2                  ANA  D          ;AND VALUE WITH MASK
92EE    C9                  RET
                    ;                   SUBROUTINE ACPR
                    ;                   STORES A IN LOCATION OF CPTR
                    ;                   LPTR IN E
92EF    5D          ACPR:   MOV  E,L        ;SAVE LPTR
92F0    69                  MOV  L,C        ;CPTR TO L.
92F1    77                  MOV  M,A        ;STORE A
92F2    6B                  MOV  L,E        ;RESTORE BASE
92F3    C9                  RET
                    ;                   SUBROUTINE DCMP
                    ;                   COMPARES TWO DOUBLE LENGTH
                    ;                   WORDS
92F4    7E          DCMP:   MOV  A,M        ;NUM MANTA TO A
92F5    5D                  MOV  E,L        ;SAVE BASE IN E
92F6    68                  MOV  L,B        ;BASE 3 TO L
92F7    BE                  CMP  M          ;COMPARE WITH DEN MANTA
92F8    6B                  MOV  L,E        ;RETURN BASE TO L
92F9    C0                  RNZ             ;RETURN IF NOT THE SAME
92FA    2C                  INR  L          ;L TO NUM MANTB
92FB    7E                  MOV  A,M        ;LOAD IT
92FC    68                  MOV  L,B        ;DEN MANTB ADD TO L
92FD    2C                  INR  L          ;BASE  4 TO L
92FE    BE                  CMP  M
92FF    6B                  MOV  L,E
9300    C0                  RNZ             ;/***TP EXTENSION
9301    2C                  INR  L          ;/NOW CHECK BYTE 3
9302    2C                  INR  L
9303    7E                  MOV  A,M        ;/GET FOR COMPARE
9304    68                  MOV  L,B
```

```
9305    2C                      INR L
9306    2C                      INR L                ;/BYTE 3 NOW
9307    BE                      CMP M                ;/COMPARE
9308    6B                      MOV L,E              ;/***TP - ALL DONE
9309    C9                      RET
                        ;                          SUBROUTINE DIVC
                        ;                          PERFORMS ONE CYCLE OF DOUBLE
                        ;                          PRECISION FLOATING PT DIVIDE
                        ;                          ENTER AT ENT1 ON FIRST CYCLE
                        ;                          ENTER AT ENT2 ALL THEREAFTER
930A    CD E9 91        ENT2:   CALL DLST            ;SHIFT MOVING DIVIDEND
930D    DA 17 93                JC   OVER            ;IF CARRY 1,NUM.GT.D
9310    CD F4 92        ENT1:   CALL DCMP            ;COMPARE NUM WITH DEN
9313    D2 17 93                JNC OVER             ;IF CARRY NOT SET,NUM.GE.DEN
9316    C9                      RET
9317    CD 26 92        OVER:   CALL DSUB            ;CALL DOUBLE SUBTRACT
931A    5D                      MOV E,L              ;SAVE BASE IN E
931B    69                      MOV L,C              ;BASE  6 TO L
931C    2C                      INR L                ;BASE  7 TO L
931D    2C                      INR L                ;/***TP
931E    7E                      MOV A,M
931F    C6 01                   ADI 1                ;ADD 1
9321    77                      MOV M,A              ;PUT IT BACK
9322    6B                      MOV L,E              ;RESTORE BASE TO L
9323    C9                      RET
                        ;                          SUBROUTINE LXFR
                        ;                          MOVES CPTR TO EPTR
                        ;                          MOVES 3 WORDS IF ENTER AT LXFR
9324    16 04           LXFR:   MVI D,4              ;/MOVE 4 WORDS
9326    69              REP5:   MOV L,C              ;CPTR TO L
9327    7E                      MOV A,M              ; CPTR> TO A
9328    6B                      MOV L,E              ;EPTR TO L
9329    77                      MOV M,A
932A    0C                      INR C                ;/INCREMENT C
932B    1C                      INR E                ;/INCREMENT E TO NEXT
932C    15                      DCR D                ;/TEST FOR DONE
932D    C2 26 93                JNZ REP5             ;/GO FOR FOR TILL D=0
9330    7B                      MOV A,E              ;/NOW RESET C AND E
9331    D6 04                   SUI 4                ;/RESET BACK BY 4
9333    5F                      MOV E,A              ;/PUT BACK IN E
9334    79                      MOV A,C              ;/NOW RESET C
```

```
9335    D6 04                    SUI 4                   ;/BY 4
9337    4F                       MOV C,A                 ;/BACK TO C
9338    C9                       RET                     ;/DONE
                         ;
                         ;   SUBROUTINE LDCP
                         ;
                         ;       THIS SUBROUTINE COMPUTES THE CHARACTERISTIC
                         ;       FOR THE FLOATING DIVIDE ROUTINE
                         ;
                         ;   REGISTERS ON EXIT:
                         ;
                         ;       A = CONDITION FLAG (SEE ERROR RETURNS)
                         ;       D,E = GARBAGE
                         ;       B,C,H,L = SAME AS ON ENTRY
                         ;
                         ;   REGISTERS ON ENTRY:
                         ;
                         ;       (H,B) = ADDRESS OFF DIVISOR
                         ;       (H,C) = ADDRESS OF QUOTIENT
                         ;       (H,L) = ADDRESS OF DIVIDEND
                         ;
9339    CD 4C 92         LDCP:    CALL    CFCHE          ;SET E=CHAR(H,B), A=CHAR(H,L)
933C    93                        SUB     E              ;SUBTRACT TO GET NEW CHARACTERISTIC
933D    C3 44 93                  JMP     CCHK           ;GO CHECK FOR OVER/UNDERFLOW
                                                         ;AND STORE CHARACTERTISTIC
                         ;
                         ;
                         ;   SUBROUTINE LMCP
                         ;
                         ;       THIS SUBROUTINE COMPUTES THE CHARACTERISTIC
                         ;       FOR THE FLOATING MULTIPLY ROUTINE.
                         ;
                         ;   REGISTERS ON EXIT:
                         ;
                         ;       A = CONDITION FLAG (SEE ERROR RETURNS)
                         ;       D,E = GARBAGE
                         ;       B,C,H,L = SAME AS ON ENTRY
                         ;
                         ;   REGISTERS ON ENTRY:
                         ;
                         ;       (H,B) = ADDRESS OFF MULTIPLICAND
```

```
                          ;       (H,C) = ADDRESS OF PRODUCT
                          ;       (H,L) = ADDRESS OF MULTIPLIER
                          ;
9340      CD 4C 92        LMCP:   CALL    CFCHE         ;SET E=CHAR(H,B), A=CHAR(H,L)
9343      83                      ADD     E             ;ADD TO GET NEW CHARACTERISTIC
                                                        ;NOW FALL INTO THE ROUTINE
                                                        ;WHICH CHECKS FOR OVER/UNDERFLOW
                                                        ;AND STORE CHARACTERTISTIC
                          ;
                          ;
                          ;   SBUROUTINE CCHK
                          ;
                          ;       THIS SUBROUTINE CHECKS A CHARACTERISTIC IN
                          ;       THE ACCUMULATOR FOR OVERFLOW OR UNDERFLOW.
                          ;       IT THEN STORES THE CHARACTERISTIC, PRESERVING
                          ;       THE PREVIOUSLY COMPUTED MANTISSA SIGN.
                          ;
                          ;  REGISTERS ON ENTRY:
                          ;
                          ;       (H,L) = ADDRESS OF ONE OPERAND
                          ;       (H,B) = ADDRESS OF OTHER OPERAND
                          ;       (H,C) = ADDRESS OF RESULT
                          ;       A     = NEW CHARACTERISTIC OF  RESULT
                          ;
                          ;   REGISTERS ON EXIT:
                          ;
                          ;       A = CONDITION FLAG (SEE ERROR RETURNS)
                          ;       D,E = GARBAGE
                          ;       B,C,H,L = SAME AS ON ENTRY
                          ;
9344                      CCHK:                         ;ENTER HERE TO CHECK CHARACTERISTIC
9344      FE 40                   CPI     100Q          ;CHECK FOR 0 TO +63
9346      DA 53 93                JC      STORC         ;JUMP IF OKAY
9349      FE 80                   CPI     200Q          ;CHECK FOR +64 TO +127
934B      DA 5B 93                JC      OFLWC         ;JUMP IF OVERFLOW
934E      FE C0                   CPI     300Q          ;CHECK FOR -128 TO -65
9350      DA 62 93                JC      UFLWC         ;JUMP IF UNDERFLOW
9353      5D              STORC:  MOV     E,L           ;SAVE L IN E
9354      69                      MOV     L,C           ;LET L POINT TO RESULT
9355      57                      MOV     D,A           ;SAVE CHARACTERISTIC IN D
9356      CD C3 92                CALL    INCR3         ;STORE CHARACTERISTIC
```

```
9359      6B                   MOV     L,E          ;RESTORE L
935A      C9                   RET                  ;RETURN
                      ;
                      ;  SUBROUTINE OFLWC
                      ;
                      ;      THIS ROUTINE WRITES A FLOATING POINT OVERFLOW AT (H,C)
                      ;      SETS THE CONDITICN FLAG, AND RETURNS.
                      ;
935B      5D          OFLWC:   MOV     E,L          ;SAVE L IN E
935C      69                   MOV     L,C          ;SET L=CPTR, SO (H,L)=ADDR OF RESULT
935D      CD 71 92             CALL    WOVR         ;WRITE OUT OVERFLOW
9360      6B                   MOV     L,E          ;RESTORE L
9361      C9                   RET                  ;RETURN
                      ;
                      ;  SUBROUTINE UFLWC
                      ;
                      ;      THIS ROUTINE WRITES A FLOATING POINT UNDERFLOW AT (H,C)
                      ;      SETS THE CONDITION FLAG, AND RETURNS.
                      ;
9362      5D          UFLWC:   MOV     E,L          ;SAVE L IN E
9363      69                   MOV     L,C          ;SET L=CPTR, SO (H,L)=ADDR OF RESULT
9364      CD 63 92             CALL    WUND         ;WRITE OUT UNDEFLOW
9367      6B                   MOV     L,E          ;RESTORE L
9368      C9                   RET                  ;RETURN
                      ;
                      ;
                      ;  SUBROUTINE CSIGN
                      ;
                      ;      THIS SUBROUTINE COMPUTES AND STORE THE MANTISSA
                      ;      SIGN FOR THE FLOATING MULTIPLY AND DIVIDE ROUTINES
                      ;
                      ;  REGISTERS ON ENTRY:
                      ;
                      ;      (H,L) = ADDRESS OF ONE OPERAND
                      ;      (H,B) = ADDRESS OF OTHER OPERAND
                      ;      (H,C) = ADDRESS OF RESULT
                      ;
                      ;  REGISTERS ON EXIT:
                      ;
                      ;      A,D,E = GARBAGE
                      ;      B,C,H,L = SAME AS ON ENTRY
```

```
                              ;
9369    CD 79 93              CSIGN:  CALL    MSFH       ;SET A=SIGN(H,L), E=SIGN(H,B)
936C    AB                            XRA     E          ;EXCLUSIVE OR SIGNS TO GET NEW SIGN
936D    CD 71 93                      CALL    CSTR       ;STORE SIGN INTO RESULT
9370    C9                            RET                ;RETURN
                              ;
                              ;
                               ;                      SUBROUTINE CSTR
                               ;                      STORES VALUE IN A IN
                               ;                      CPTR 2
                               ;                      PUTS LPTR IN E
9371    5D                     CSTR:  MOV E,L          ;SAVE LPTR IN E
9372    69                            MOV L,C          ;CPTR TO L
9373    2C                            INR L            ;CPTR 2
9374    2C                            INR L            ;TO L
9375    2C                            INR L            ;/***TP
9376    77                            MOV M,A          ;STORE ANSWER
9377    6B                            MOV L,E          ;LPTR BACK TO L
9378    C9                            RET
                              ;
                              ;   SUBROUTINE MSFH
                              ;
                              ;       THIS SUBROUTINE FETCHES THE SIGNS OF THE MANTISSAS
                              ;       OF THE FLOATING POINT NUMBERS POINTED TO BY (H,L)
                              ;       AND (H,B) INTO THE A AND E REGISTERS RESPECTIVELY.
                              ;
                              ;   REGISTERS ON EXIT:
                              ;
                              ;       A = SIGN  OF MANTISSA OF (H,L)
                              ;       E = SIGN OF MANTISSA OF (H,B)
                              ;       B,C,D,H,L = SAME AS ON ENTRY
                              ;
9379    5D                     MSFH:  MOV E,L          ;SAVE LPTR
937A    68                            MOV L,B          ;BPTR TO L
937B    2C                            INR L            ;BPTR 2
937C    2C                            INR L            ;/***TP
937D    2C                            INR L            ;TO L
937E    7E                            MOV A,M          ; BPTR 2>TO A
937F    E6 80                         ANI 128          ;SAVE MANT SIGN
9381    6B                            MOV L,E          ;LPTR BACK TO L
```

```
9382     5F                        MOV E,A           ;STORE BPTR MANT SIGN
9383     2C                        INR L             ;LPTR 2
9384     2C                        INR L             ;/***TP
9385     2C                        INR L             ;TO L
9386     7E                        MOV A,M           ; LPTR 2>TO A
9387     E6  80                    ANI 128           ;SAVE LPTR MANT SIGN
9389     2D                        DCR L             ;LPTR BACK
938A     2D                        DCR L             ;TO L
938B     2D                        DCR L             ;/***TP
938C     C9                        RET
                          ;                        SUBROUTINE BCTL
                          ;                        MOVES BPTR CHAR TO LPTR CHAR
                          ;                        DESTROYSE
938D     5D               BCTL:    MOV E,L           ;LPTR TO E
938E     68                        MOV L,B           ;BPTR TO L
938F     2C                        INR L             ;BPTR  2
9390     2C                        INR L             ;/***TP
9391     2C                        INR L             ;TO L
9392     7E                        MOV A,M           ;BPTR CHAR TO A
9393     6B                        MOV L,E           ;LPTR TO L
9394     2C                        INR L             ;LPTR  2
9395     2C                        INR L             ;TO L
9396     2C                        INR L             ;/***TP
9397     77                        MOV M,A           ;STORE BPTR CHAR IN LPTR CHAR
9398     6B                        MOV L,E           ;LPTR TO L
9399     C9                        RET
                          ;
                          ;*******************************************************
                          ;        //// 5 DIGIT FLOATING PT. OUTPUT
                          ;*******************************************************
                          ;
                          ;
                          ;
                          ;
                          ;
                          ;        *******ROUTINE TO CONVERT FLOATING PT.
                          ;        ***NUMBERS TO ASCII AND OUTPUT THEM VIA A SUBROUTINE
                          ;        ***CALLED OUTR  -  NOTE: THIS IS CURRENTLY SET
                          ;        ***TO ODT'S OUTPUT ROUTINE
                          ;
                          ;
```

```
939A     CD DA 91      CVRT:     CALL    ZCHK            ;CHECK FOR NEW ZERO
939D     C2 AF 93                JNZ     NNZRO           ;NOT ZERO
93A0     0C                      INR     C               ;IT WAS, OFFSET C BY 2
93A1     0C                      INR     C
93A2     69                      MOV     L,C
93A3     CD 8D 92                CALL    WZER            ;WRITE ZERO
93A6     2C                      INR     L               ;PNT TO DECIMAL EXPONENT
93A7     2C                      INR     L
93A8     2C                      INR     L
93A9     2C                      INR     L
93AA     AF                      XRA     A               ;SET IT TO ZERO
93AB     77                      MOV     M,A
93AC     C3 0E 94                JMP     MDSKP           ;OUTPUT IT
93AF     56            NNZRO:    MOV     D,M             ;/GET THE NUMBER TO CONVERT
93B0     2C                     INR L
93B1     46                     MOV B,M
93B2     2C                     INR L
93B3     5E                     MOV E,M
93B4     2C                     INR L             ;/4 WORD***TP
93B5     7E                     MOV A,M           ;/***TP
93B6     0C                     INR C             ;/OFFSET SCRATCH POINTER BY 2
93B7     0C                     INR C
93B8     69                     MOV L,C           ;/L NOT NEEDED ANY MORE
93B9     72                     MOV M,D           ;/SAVE NUMBER IN SCRATCH
93BA     2C                     INR L
93BB     70                     MOV M,B
93BC     2C                     INR L
93BD     73                     MOV M,E           ;/***TP
93BE     2C                     INR L             ;/***TP
93BF     47                     MOV B,A           ;/SAVE COPY OF CHAR & SIGN
93C0     E6 7F                  ANI 177Q          ;GET ONLY CHAR.
93C2     77                     MOV M,A           ;/SAVE ABS(NUMBER)
93C3     FE 40                  CPI 100Q          ;CK FOR ZERO
93C5     CA CC 93               JZ  NZRO
93C8     D6 01                  SUI 1             ;/GET SIGN OF DEC. EXP
93CA     E6 40                  ANI 100Q          ;/GET SIGN OF CHAR.
93CC     07             NZRO:   RLC               ;MOVE IT TO SIGN POSITION
93CD     2C                     INR L             ;/MOVE TO DECIMAL EXP.
93CE     77                     MOV M,A           ;/SAVE SIGN OF EXP.
93CF     78                     MOV A,B           ;/GET MANT. SIGH BACK
93D0     CD 90 94               CALL SIGN         ;/OUTPUT SIGN
```

```
93D3    2E 14                  MVI L,(TEN5 AND 377Q)  ;/TRY MULT. ØR DIV. BY 100000 FIRST
93D5    CD F1 94               CALL CØPT             ;/MAKE A CØPY IN RAM
93D8    CD 9D 94     TST8:     CALL GCHR             ;/GET CHAR. ØF NUMBER
93DB    47                     MØV B,A               ;/SAVE A CØPY
93DC    E6 40                  ANI 100Q              ;/GET ABSØLUTE VALUE ØF CHAR
93DE    78                     MØV A,B               ;/INCASE PLUS
93DF    CA E5 93               JZ  GØTV              ;/ALREADY PLUS
93E2    3E 80                  MVI A,200Q            ;/MAKE MINUS INTØ PLUS
93E4    90                     SUB B                 ;/PLUS=200B-CHAR
93E5    FE 12        GØTV:     CPI 22Q               ;/TEST FØR USE ØF 100000
93E7    FA F3 93               JM  TRY1              ;/WØNT GØ
93EA    CD A3 94               CALL MØRD             ;/WILL GØ SØ DØ IT
93ED    C6 05                  ADI 5                 ;/INCREMENT DEC. EXPØNENT BY 5
93EF    77                     MØV M,A               ;/UPDATE MEM
93F0    C3 D8 93               JMP TST8              ;/GØ TRY AGAIN
93F3    2E 18        TRY1:     MVI L,(TEN AND 377Q)  ;/NØW USE JUST TEN
93F5    CD F1 94               CALL CØPT             ;/PUT IT IN RAM
93F8    CD 9D 94     TST1:     CALL GCHR             ;/GET CHARACTERISTIC
93FB    FE 01                  CPI 1                 ;/MUST GET IN RANGE 1 TØ 6
93FD    F2 09 94               JP  ØK1               ;/ATLEAST ITS 1 ØR BIGGER
9400    CD A3 94     MDGN:     CALL MØRD             ;/MUST MUL ØF DIV BY 10
9403    C6 01                  ADI 1                 ;/INCREMENT DECIMAL EXP.
9405    77                     MØV M,A               ;/UPDATE MEM
9406    C3 F8 93               JMP TST1              ;/NØW TRY AGAIN
9409    FE 07        ØK1:      CPI 7                 ;/TEST FØR LESS THAN 7
940B    F2 00 94               JP  MDGN              ;/NØPE - 7 ØR GREATER
940E    69           MDSKP:     MØV    L,C                 ;/SET UP DIGIT CØUNT
940F    2D                     DCR L
9410    2D                     DCR L                 ;/IN 1ST WØRD ØF SCRATCH
9411    36 05                  MVI M,5               ;/5 DIGITS
9413    5F                     MØV E,A               ;/SAVE CHAR. AS LEFT SHIFT CØUNT
9414    CD 76 94               CALL LSFT             ;/SHIFT LEFT PRØPER NUMBER
9417    FE 0A                  CPI 12Q               ;/TEST FØR 2 DIGITS HERE
9419    F2 C9 94               JP  TWØD              ;/JMP IF 2 DIGITS TØ ØUTPUT
941C    CD 3A 94               CALL DIGØ             ;/ØUTPUT FIRST DIGIT
941F    CD 4E 94     PØPD:     CALL MULTT            ;/MULTIPLY THE NUMBER BY 10
9422    CD 3A 94     INPØP:    CALL DIGØ             ;/PRINT DIGIT IN A
9425    C2 1F 94               JNZ PØPD              ;/MØRE DIGITS?
9428    3E C5                  MVI A,305Q            ;/NØ SØ PRINT E
942A    CD FD 97               CALL ØUTR             ;/BASIC CALL TØ ØUTPUT
942D    CD BE 94               CALL GETEX            ;/GET DECIMAL EXP
```

```
9430    47                  MOV B,A         ;/SAVE A COPY
9431    CD 90 94            CALL SIGN       ;/OUTPUT SIGN
9434    78                  MOV A,B         ;/GET EXP BACK
9435    E6 3F               ANI 77Q         ;/GET GOOD BITS
9437    CD E0 94            CALL CTWO       ;/GO CONVERT 2 DIGITS
943A    C6 B0       DIGO:   ADI 260Q        ;/MAKE A INTO ASCII
943C    CD FD 97            CALL OUTR       ;/OUTPUT DIGIT
943F    69                  MOV L,C         ;/GET DIGIT COUNT
9440    2D                  DCR L           ;/BACK UP TO DIGIT COUNT
9441    2D                  DCR L
9442    7E                  MOV A,M         ;/TEST FOR DECIMAL PT
9443    FE 05               CPI 5           ;/PRINT . AFTER 1ST DIGIT
9445    3E AE               MVI A,256Q      ;/JUST IN CASE
9447    CC FD 97            CZ  OUTR        ;/OUTPUT . IF 1ST DIGIT
944A    56                  MOV D,M         ;/NOW DECREMENT DIGIT COUNT
944B    15                  DCR D
944C    72                  MOV M,D         ;/UPDATE MEM AND LEAVE FLOPS SET
944D    C9                  RET             ;/SERVES AS TERM FOR DIGO & CVRT
944E    1E 01       MULTT:  MVI E,1         ;/MULT. BY 10 (START WITH X2)
9450    CD 76 94            CALL LSFT       ;/LEFT SHIFT 1 = X2
9453    69                  MOV L,C         ;/SAVE X2 IN "RESULT"
9454    2D                  DCR L           ;/SET TO TOP OF NUMBER
9455    79                  MOV A,C         ;/SET C TO RESULT
9456    C6 09               ADI 11Q
9458    4F                  MOV C,A         ;/NOW C SET RIGHT
9459    7C                  MOV A,H         ;/SHOW RAM TO RAM TRANSFER
945A    CD FF 94            CALL COPY       ;/SAVE X2 FINALLY
945D    79                  MOV A,C         ;/MUST RESET C
945E    D6 09               SUI 11Q         ;/BACK TO NORMAL
9460    4F                  MOV C,A
9461    1E 02               MVI E,2         ;/NOW GET (X2)X4=X8
9463    69                  MOV L,C         ;/BUT MUST SAVE OVERFLOW
9464    2D                  DCR L
9465    CD 7A 94            CALL TLP2       ;/GET X8
9468    69                  MOV L,C         ;/SET UP TO CALL DADD
9469    79                  MOV A,C         ;/SET B TO X2
946A    C6 0A               ADI 12Q         ;/TO X2
946C    47                  MOV B,A
946D    CD 06 92            CALL DADD       ;/ADD TWO LOW WORDS
9470    2D                  DCR L           ;/BACK UP TO OVERFLOW
9471    7E                  MOV A,M         ;/GET IT
```

```
9472    68                       MOV L,B          ;/NOW SET TO X2 OVERFLOW
9473    2D                       DCR L            ;/ITS AT B-1
9474    8E                       ADC M            ;/ADD WITH CARRY - CARRY WAS PRESERVED
9475    C9                       RET              ;/ALL DONE, RETURN OVERFLOW IN A
9476    69              LSFT:    MOV L,C          ;/SET PTR FOR LEFT SHIFT OF NUMBER
9477    2D                       DCR L            ;/BACK UP TO OVERFLOW
9478    AF                       XRA A            ;/OVERFLOW=0 1ST TIME
9479    77              TLOOP:   MOV M,A          ;/SAVE OVERFLOW
947A    1D              TLP2:    DCR E            ;/TEST FOR DONE
947B    F8                       RM               ;/DONE WHEN E MINUS
947C    2C                       INR L            ;/MOVE TO LOW
947D    2C                       INR L
947E    2C                       INR L            ;/***TP EXTENSION
947F    7E                       MOV A,M          ;/SHIFT LEFT 4 BYTES
9480    17                       RAL
9481    77                       MOV M,A          ;/PUT BACK
9482    2D                       DCR L            ;/***TP - ALL DONE
9483    7E                       MOV A,M          ;/GET LOW
9484    17                       RAL              ;/SHIFT LEFT 1
9485    77                       MOV M,A          ;/RESTORE IT
9486    2D                       DCR L            ;/BACK UP TO HIGH
9487    7E                       MOV A,M          ;/GET HIGH
9488    17                       RAL              ;/SHIFT IT LEFT WITH CARRY
9489    77                       MOV M,A          ;/PUT IT BACK
948A    2D                       DCR L            ;/BACK UP TO OVERFLOW
948B    7E                       MOV A,M          ;/GET OVERFLOW
948C    17                       RAL              ;/SHIFT IT LEFT
948D    C3 79 94                 JMP TLOOP        ;/GO FOR MORE
9490    E6 80           SIGN:    ANI 200Q         ;/GET SIGN BIT
9492    3E A0                    MVI A,240Q       ;/SPACE INSTEAD OF PLUS
9494    CA 99 94                 JZ  PLSV         ;/TEST FOR +
9497    3E AD                    MVI A,255Q       ;/NEGATIVE
9499    CD FD 97        PLSV:    CALL OUTR        ;/OUTPUT SIGN
949C    C9                       RET
949D    69              GCHR:    MOV L,C          ;/GET CHARCTERISTIC
949E    2C              GETA:    INR L            ;/MOVE TO IT
949F    2C                       INR L
94A0    2C                       INR L            ;/***TP
94A1    7E                       MOV A,M          ;/FETCH INTO A
94A2    C9                       RET              ;/DONE
94A3    CD BE 94        MORD:    CALL GETEX       ;/MUL OR DIV DEPENDING ON EXP
```

```
94A6    5F                  MOV  E,A      ;/SAVE DECIMAL EXP
94A7    45                  MOV  B,L      ;/SET UP TO MULT OR DIV
94A8    04                  INR  B        ;/NOW BOP POINTER SET
94A9    69                  MOV  L,C      ;/L POINTS TO NUMBER TO CONVERT
94AA    79                  MOV  A,C      ;/POINT C AT "RESULT" AREA
94AB    C6 09               ADI  11Q      ;/IN SCRATCH
94AD    4F                  MOV  C,A      ;/NOW C SET RIGHT
94AE    7B                  MOV  A,E      ;/NOW TEST FOR MUL
94AF    E6 80               ANI  200Q     ;/TEST NEGATIVE DEC. EXP.
94B1    CA C3 94            JZ   DIVIT    ;/IF EXP IS + THEN DIVIDE
94B4    CD 5F 91            CALL LMUL     ;/MULT.
94B7    79         FINUP:   MOV  A,C      ;/SAVE LOC. OF RESULT
94B8    4D                  MOV  C,L      ;/C=LOC OF NUMBER (IT WAS DESTROYED)
94B9    6F                  MOV  L,A      ;/SET L TO LOC. OF RESUTL
94BA    7C                  MOV  A,H      ;/SHOW RAM TO RAM TRANSFER
94BB    CD FF 94            CALL COPY     ;/MOVE RESULT TO NUMBER
94BE    69         GETEX:   MOV  L,C      ;/NOW GET DECIMAL EXP
94BF    2C                  INR  L
94C0    C3 9E 94            JMP  GETA     ;/USE PART OF GCHR
94C3    CD 00 90   DIVIT:   CALL LDIV     ;/DIVIDE
94C6    C3 B7 94            JMP  FINUP
94C9    CD E0 94   TWOD:    CALL CTWO     ;/CONVERT TO 2 DIGITS
94CC    47                  MOV  B,A      ;/SAVE ONES DIGIT
94CD    CD BE 94            CALL GETEX    ;/GET DECIMAL EXP
94D0    5F                  MOV  E,A      ;/SAVE A COPY
94D1    E6 80               ANI  200Q     ;/TEST FOR NEGATIVE
94D3    CA DC 94            JZ   ADD1     ;/BUMP EXP BY 1 SINCE 2 DIGITS
94D6    1D                  DCR  E        ;/DECREMENT NEGATIVE EXP SINCE 2 DIGITS
94D7    73         FINIT:   MOV  M,E      ;/RESTORE EXP WITH NEW VALUE
94D8    78                  MOV  A,B      ;/NOW DO 2ND DIGIT
94D9    C3 22 94            JMP  INPOP    ;/GO OUT 2ND AND REST FO DIGITS
94DC    1C         ADD1:    INR  E        ;/COMPENSATE FOR 2 DIGITS
94DD    C3 D7 94            JMP  FINIT
94E0    1E FF      CTWO:    MVI  E,377Q   ;/CONVERT 2 DIGIT BIN TO BCD
94E2    1C         LOOP:    INR  E        ;/ADD UP TENS DIGIT
94E3    D6 0A               SUI  12Q      ;/SUBTRACT 10
94E5    F2 E2 94            JP   LOOP     ;/TIIL NEGATIVE RESULT
94E8    C6 0A               ADI  12Q      ;/RESTORE ONES DIGIT
94EA    47                  MOV  B,A      ;/SAVE ONES DIGIT
94EB    7B                  MOV  A,E      ;/GET TENS DIGIT
94EC    CD 3A 94            CALL DIGO     ;/OUTPUT IT
```

```
94EF     78                        MOV A,B          ;/SET A TO 2ND DIGIT
94F0     C9                        RET
94F1     79               COPT:    MOV A,C          ;/COPY FROM 10 N TO RAM
94F2     C6 05                     ADI 5
94F4     4F                        MOV C,A          ;/SET C TO PLACE TO PUT
94F5     3E 95                     MVI A,(TEN5/256)
94F7     CD FF 94                  CALL COPY        ;/COPY IT
94FA     79                        MOV A,C          ;/NOW RESET C
94FB     D6 05                     SUI 5
94FD     4F                        MOV C,A          ;/ITS RESET
94FE     C9                        RET
94FF     44               COPY:    MOV B,H          ;/SAVE RAM H
9500     67                        MOV H,A          ;/SET TO SOURCE H
9501     7E                        MOV A,M          ;/GET 4 WORDS INTO THE REGS.
9502     2C                        INR L
9503     56                        MOV D,M
9504     2C                        INR L
9505     5E                        MOV E,M
9506     2C                        INR L
9507     6E                        MOV L,M          ;/LAST ONE ERASES L
9508     60                        MOV H,B          ;/SET TO DESTINATION RAM
9509     45                        MOV B,L          ;/SAVE 4TH WORD IN B
950A     69                        MOV L,C          ;/SET TO DESTINATION
950B     77                        MOV M,A          ;/SAVE FIRST WORD
950C     2C                        INR L
950D     7E                        MOV A,M          ;/SAVE THIS WORD IN A (INPUT SAVES C HERE
950E     72                        MOV M,D          ;/NOW PUT 2ND WORD
950F     2C                        INR L
9510     73                        MOV M,E
9511     2C                        INR L
9512     70                        MOV M,B          ;/ALL 4  COPIED NOW
9513     C9                        RET              ;/ALL DONE
                          ;
9514     C3 50 00 11      TEN5:   DB 303Q,120Q,0Q,21Q  ;/303240(8) = 100000.
9518     A0 00 00 04      TEN:    DB 240Q,0Q,0Q,4Q  ;/12(8) = 10
                          ;
                          ;        SCRATCH MAP FOR I/O CONVERSION ROUTINES
                          ;
                          ;        RELATIVE TO (C+2)USE
                          ;        C-2                 DIGIT COUNT
```

```
                        ;          C-1                     OVERFLOW
                        ;          C                       HIGH NUMBER - MANTISSA
                        ;          C+1                     LOW NUMBER
                        ;          C+2                     CHARACTERISTIC
                        ;          C+3                     DECIMAL EXPONEXT (SIGN & MAG.)
                        ;          C+4                     TEN**N
                        ;          C+5                     TEN**N
                        ;          C+6                     TEN**N
                        ;          C+7                     RESULT OF MULT & DIV
                        ;          C+8                     AND TEMP FOR X2
                        ;          C+9                     "       "
                        ;          C+10                    L FOR NUMBER TO GO INTO (INPUT ONLY)
                        ;          C+11                    DIGIT JUST INPUT (INPUT ONLY)
                        ;
                        ;                                  /*****BEGIN INPUT************
                        ;
951C    37              ERR:        STC                             ;ERROR FLAG
951D    C9                          RET                             ;AND RETURN
                        ;
                        ;*****************************************************
                        ;          //// 4 1/2 DIGIT INPUT ROUTINE
                        ;****************************************************
                        ;
                        ;
                        ;                                  /L POINTS TO WHERE TO PUT INPUT NUMBER
                        ;                                  /C POINTS TO 13(10) WORDS OF SCRATCH
                        ;
951E    45              INPUT:     MOV B,L              ;/SAVE ADDRESS WHERE DATA IS TO GO
951F    79                         MOV A,C              ;/IN SCRATCH
9520    C6 0F                      ADI 17Q              ;/COMPUTE LOC. IN SCRATCH
9522    6F                         MOV L,A
9523    70                         MOV M,B              ;/PUT IT
9524    0C                         INR C                ;/OFFSET SCRATCH POINTER
9525    0C                         INR C                ;/BY 2
9526    CD 2D 96                   CALL ZROIT           ;/ZERO NUMBER
9529    2C                         INR L                ;/AND ZERO
952A    77                         MOV M,A              ;/DECIMAL EXPONENT
952B    CD C9 95                   CALL GNUM            ;/GET INTEGER PART OF NUM
952E    FE FE                      CPI 376Q             ;/TERM=.?
```

```
9530     CA 83 95             JZ   DECPT          ;/YES
9533     FE 15       TSTEX:   CPI  25Q            ;/TEST FOR E
9535     CA 98 95             JZ   INEXP          ;/YES - HANDLE EXP
9538     FE F0                CPI  360Q           ;/TEST FOR SPACE TERM (240B-260B)
953A     C2 1C 95             JNZ  ERR            ;/NOT LEGAL TERM
953D     CD 12 96             CALL FLTSGN         ;/FLOAT # AND SIGN IT
9540     CD BE 94    SCALE:   CALL GETEX          ;/GET DECIMAL EXP
9543     E6 7F                ANI  177Q           ;/GET GOOD BITS
9545     5F                   MOV  E,A            ;/SAVE COPY
9546     E6 40                ANI  100Q           ;/GET SIGN OF EXP
9548     07                   RLC                 ;/INTO SIGN BIT
9549     B7                   ORA  A              ;/SET FLOPS
954A     47                   MOV  B,A            ;/SAVE SIGN
954B     7B                   MOV  A,E            ;/GET EXP BACK
954C     CA 52 95             JZ   APLS           ;/JMP IS +
954F     3E 80                MVI  A,200Q         ;/MAKE MINUS +
9551     93                   SUB  E              ;/NOW ITS +
9552     80          APLS:    ADD  B              ;/SIGN NUMBER
9553     77                   MOV  M,A            ;/SAVE EXP (SIGN & MAG.)
9554     2E 14                MVI  L,(TEN5 AND 377Q)   ;/TRY MORD WITH 10**5 FIRST
9556     CD F1 94             CALL COPT           ;/TRANSFER TO RAM
9559     CD BE 94             CALL GETEX          ;/GET DECIMAL EXP
955C     E6 3F       INT5:    ANI  77Q            ;/GET MAG. OF EXP
955E     FE 05                CPI  5Q             ;/TEST FOR USE OF 10**5
9560     FA 6C 95             JM   TRYTN          ;/WONT GO - TRY 10
9563     CD A3 94             CALL MORD           ;/WILL GO SO DO IT
9566     D6 05                SUI  5Q             ;/MAG = MAG -5
9568     77                   MOV  M,A            ;/UPDATE DEC. EXP IN MEM
9569     C3 5C 95             JMP  INT5           ;/GO TRY AGAIN
956C     2E 18       TRYTN:   MVI  L,(TEN AND 377Q)   ;/PUT TEN IN RAM
956E     CD F1 94             CALL COPT
9571     CD BE 94             CALL GETEX          ;/SET UP FOR LOOP
9574     E6 3F       INT1:    ANI  77Q            ;/GET MAGNITUDE
9576     B7                   ORA  A              ;/TEST FOR 0
9577     CA 16 96             JZ   SAVEN          ;/DONE, MOVE NUM OUT AND GET OUT
957A     CD A3 94             CALL MORD           ;/NOT DONE - DO 10
957D     D6 01                SUI  1Q             ;/EXP = EXP -1
957F     77                   MOV  M,A            ;/UPDATE MEM
9580     C3 74 95             JMP  INT1           ;/TRY AGAIN
9583     69          DECPT:   MOV  L,C            ;/ZERO DIGIT COUNT
9584     2D                   DCR  L              ;/SINCE ITS NECESSARY
```

```
9585    2D                   DCR L           ;/TO COMPUTE EXP.
9586    36 00                MVI M,0         ;/ZEROED
9588    CD 0C 96             CALL EP1        ;/GNUM IN MIDDLE
958B    5F                   MOV E,A         ;/SAVE TERMINATOR
958C    69                   MOV L,C         ;/MOVE DIGIT COUNT TO EXP
958D    2D                   DCR L           ;/BACK UP TO DIGIT COUNT
958E    2D                   DCR L
958F    46                   MOV B,M         ;/GOT DIGIT COUNT
9590    CD BE 94             CALL GETEX      ;/SET L TO DEC. EXP
9593    70                   MOV M,B         ;/PUT EXP
9594    7B                   MOV A,E         ;/TERM BACK TO A
9595    C3 33 95             JMP TSTEX       ;/TEST FOR E+OR-XX
9598    CD 12 96     INEXP:  CALL FLTSGN     ;/FLOAT AND SIGN NUMBER
959B    CD 16 96             CALL SAVEN      ;/SAVE NUMBER IN (L) TEMP
959E    CD 2D 96             CALL ZROIT      ;/ZERO OUT NUM. FOR INPUTTING EXP
95A1    CD C9 95             CALL GNUM       ;/NOW INPUT EXPONENT
95A4    FE F0                CPI 360Q        ;/TEST FOR SPACE TERM.
95A6    C2 1C 95             JNZ ERR         ;/NOT LEGAL - TRY AGAIN
95A9    69                   MOV L,C         ;/GET EXP OUT OF MEM
95AA    2C                   INR L           ;/***TP
95AB    2C                   INR L           ;/EXP LIMITED TO 5 BITS
95AC    7E                   MOV A,M         ;/GET LOWEST 8 BITS
95AD    E6 1F                ANI 37Q         ;/GET GOOD BITS
95AF    47                   MOV B,A         ;/SAVE THEM
95B0    2C                   INR L           ;/GET SIGN OF EXP
95B1    7E                   MOV A,M         ;/INTO A
95B2    B7                   ORA A           ;/SET FLOPS
95B3    78                   MOV A,B         ;/INCASE NOTHING TO DO
95B4    FA BA 95             JM  USEIT       ;/IF NEG. USE AS +
95B7    3E 00                MVI A,0Q        ;/IF + MAKE -
95B9    90                   SUB B           ;/0-X = -X
95BA    2C           USEIT:  INR L           ;/POINT AT EXP
95BB    86                   ADD M           ;/GET REAL DEC. EXP
95BC    77                   MOV M,A         ;/PUT IN MEM
95BD    79                   MOV A,C         ;/NOW GET NUMBER BACK
95BE    C6 0D                ADI 15Q         ;/GET ADD OF L
95C0    6F                   MOV L,A         ;/L POINTS TO L OF NUMBER
95C1    6E                   MOV L,M         ;/NOW L POINTS TO NUMBER
95C2    7C                   MOV A,H         ;/RAM TO RAM COPY
95C3    CD FF 94             CALL COPY       ;/COPY IT BACK
95C6    C3 40 95             JMP SCALE       ;/NOW ADJUST FOR EXP
```

```
95C9    CD FA 97    GNUM:  CALL INP       ;/GET A CHAR
95CC    FE A0              CPI  240Q      ;/IGNORE LEADING SPACES
95CE    CA C9 95           JZ   GNUM
95D1    FE AD              CPI  255Q      ;/TEST FOR -
95D3    C2 DF 95           JNZ  TRYP      ;/NOT MINUS
95D6    69                 MOV  L,C       ;/MINUS SO SET SIGN
95D7    2C                 INR  L         ;/IN CHAR LOC.
95D8    2C                 INR  L         ;/***TP
95D9    2C                 INR  L
95DA    36 80              MVI  M,200Q    ;/SET - SIGN
95DC    C3 C9 95           JMP  GNUM
95DF    FE AB       TRYP:  CPI  253Q      ;/IGNORE +
95E1    CA C9 95           JZ   GNUM
95E4    D6 B0       TSTN:  SUI  260Q      ;/STRIP ASCII
95E6    F8                 RM             ;/RETURN IF TERM
95E7    FE 0A              CPI  12Q       ;/TEST FOR NUMBER
95E9    F0                 RP             ;/ILLEGAL
95EA    5F                 MOV  E,A       ;/SAVE DIGIT
95EB    CD 27 96           CALL GETN      ;/LOC. OF DIGIT STORAGE TO L
95EE    73                 MOV  M,E       ;/SAVE DIGIT
95EF    CD 4E 94           CALL MULTT     ;/MULT NUMBER BY 10
95F2    B7                 ORA  A         ;/TEST FOR TOO MANY DIGITS
95F3    C0                 RNZ            ;/TOO MANY DIGITS
95F4    CD 27 96           CALL GETN      ;/GET DIGIT
95F7    69                 MOV  L,C       ;/SET L TO NUMBER
95F8    2C                 INR  L
95F9    2C                 INR  L         ;/***TP
95FA    86                 ADD  M         ;/ADD IN THE DIGIT
95FB    77                 MOV  M,A       ;/PUT RESULT BACK
95FC    2D                 DCR  L         ;/NOW DO HIGH
95FD    7E                 MOV  A,M       ;/GET HIGH TO ADD IN CARRY
95FE    CE 00              ACI  0Q        ;/ADD IN CARRY
9600    77                 MOV  M,A       ;/UPDATE HIGH
9601    2D                 DCR  L         ;/***TP EXTENSION
9602    7E                 MOV  A,M
9603    CE 00              ACI  0Q        ;/ADD IN CARRY
9605    77                 MOV  M,A       ;/***TP ALL DONE
9606    D8                 RC             ;/OVERFLOW ERROR
9607    2D                 DCR  L         ;/BUMP DIGIT COUNT NOW
9608    2D                 DCR  L
9609    46                 MOV  B,M       ;/GET DIGIT COUNT
```

```
960A    04                   INR B              ;/BUMP DIGIT COUNT
960B    70                   MOV M,B            ;/UPDATE DIGIT COUNT
960C    CD FA 97    EP1:     CALL INP           ;/GET NEXT CHAR
960F    C3 E4 95             JMP TSTN           ;/MUST BE NUM. OR TERM
9612    69         FLTSGN:   MOV     L,C          ;POINT L AT NUMBER TO FLOAT
9613    C3 D5 91             JMP     FLOAT        ;GO FLOAT IT
9616    79          SAVEN:   MOV A,C            ;/PUT NUMBER IN (L)
9617    C6 0D                ADI 15Q            ;/GET ADD OF L
9619    6F                   MOV L,A
961A    5E                   MOV E,M            ;/GET L OF RESULT
961B    6B                   MOV L,E            ;/POINT L AT (L)
961C    2C                   INR L              ;/SET TO 2ND WORD TO SAVE C
961D    71                   MOV M,C            ;/SAVE C IN (L) +1 SINCE IT WILL BE DESTROYED
961E    69                   MOV L,C            ;/SET UP TO CALL COPY
961F    4B                   MOV C,E            ;/NOW L&C SET
9620    7C                   MOV A,H            ;/RAM TO RAM COPY
9621    CD FF 94             CALL COPY          ;/COPY TO L
9624    4F                   MOV C,A            ;/(L)+1 RETURNED HERE SO SET AS C
9625    B7                    ORA     A                ;MAKE SURE CY=0 (NO ERROR)
9626    C9                   RET                ;/NOW EVERYTHING HUNKY-DORRY
9627    79          GETN:    MOV A,C            ;/GET DIGIT
9628    C6 0E                ADI 16Q            ;/LAST LOC. IN SCRATCH
962A    6F                   MOV L,A            ;/PUT IN L
962B    7E                   MOV A,M            ;/GET DIGIT
962C    C9                   RET
962D    69          ZROIT:   MOV L,C            ;/ZERO NUMBER
962E    AF                   XRA A
962F    77                   MOV M,A            ;/***TP
9630    2C                   INR L              ;/***TP
9631    77                   MOV M,A
9632    2C                   INR L
9633    77                   MOV M,A
9634    2C                   INR L              ;/NOW SET SIGN TO +
9635    77                   MOV M,A
9636    C9                   RET                ;/DONE
                   ; CONTAIN LOW BYTE OF TWO BYTE VALUE. RETURNS CY=1 IF
                   ; BC>DE, CY=0 IF BC<DE: Z=1 IF BC=DE.
9637    7B         DCOMP:     MOV     A,E
9638    B9                    CMP     C
9639    C0                    RNZ
963A    7A                    MOV     A,D
```

```
963B    B8                    CMP     B
963C    C9                    RET
                    ; ROUTINE TO INPUT CHAR FROM TTY
963D    C5          CHAR2:    PUSH    B
963E    CD 04 01              CALL    CONIN             ;INPUT FROM ODT
9641    78                    MOV     A,B               ;GET CHAR TO A REG.
9642    C1                    POP     B                 ;RESTORE B,C
9643    C9                    RET
                    ; ROUTINE TO ADJUST VALUES OF BIN, FORWARD PNT. AND
                    ; LINE LENGTH OF SOURCE LINE.  PASSED ADD OF TEMP VARIABLE
                    ; CONTAINING ADD OF SOURCE LINE.
9644    F5          PTVAL:    PUSH    PSW
9645    D5                    PUSH    D
9646    E5                    PUSH    H
9647    3E 02                 MVI     A,002
9649    5E                    MOV     E,M
964A    2C                    INR     L
964B    56                    MOV     D,M
964C    2C                    INR     L
964D    D5                    PUSH    D
964E    E3          N1:       XTHL
964F    5E                    MOV     E,M
9650    23                    INX     H
9651    56                    MOV     D,M
9652    23                    INX     H
9653    E3                    XTHL
9654    73                    MOV     M,E
9655    2C                    INR     L
9656    72                    MOV     M,D
9657    2C                    INR     L
9658    3D                    DCR     A
9659    C2 4E 96              JNZ     N1
965C    E3                    XTHL
965D    56                    MOV     D,M
965E    E1                    POP     H
965F    72                    MOV     M,D
9660    E1                    POP     H
9661    D1                    POP     D
9662    F1                    POP     PSW
9663    C9                    RET
                    ; ROUTINE TO CHK FLAGS ON INPUT AND OUTPUT.
```

```
                          ; PASSED FLAG VALUE IN REG B.
9664    F5                MCHK:     PUSH    PSW
9665    CD 0A 01          MCHK1:    CALL    STATUS
9668    A0                          ANA     B
9669    CA 65 96                    JZ      MCHK1
966C    F1                          POP     PSW
966D    C9                          RET
                          ; MULTIPLICATION ROUTINE (ADD. VALUES)
966E    5E                MULT:     MOV     E,M
966F    2B                          DCX     H
9670    56                          MOV     D,M
9671    36 11                       MVI     M,11H
9673    06 00                       MVI     B,0
9675    48                          MOV     C,B
9676    7B                TOP:      MOV     A,E
9677    1F                          RAR
9678    5F                          MOV     E,A
9679    7A                          MOV     A,D
967A    1F                          RAR
967B    35                          DCR     M
967C    57                          MOV     D,A
967D    C8                          RZ
967E    D2 8B 96                    JNC     SHIFT
9681    2B                          DCX     H
9682    2B                          DCX     H
9683    78                          MOV     A,B
9684    86                          ADD     M
9685    47                          MOV     B,A
9686    23                          INX     H
9687    79                          MOV     A,C
9688    8E                          ADC     M
9689    4F                          MOV     C,A
968A    23                          INX     H
968B    79                SHIFT:    MOV     A,C
968C    1F                          RAR
968D    4F                          MOV     C,A
968E    78                          MOV     A,B
968F    1F                          RAR
9690    47                          MOV     B,A
9691    C3 76 96                    JMP     TOP
                          ;LINKAGES TO FLOATING POINT ROUTINES
```

```
97C7                                      ORG    113707Q
97C7      C3 AD 91                        JMP    NORM
97CA      C3 D5 91                        JMP    FLOAT
97CD      C3 8D 92                        JMP    WZER
97D0      C3 5C 90                        JMP    LADD
97D3      C3 5F 91                        JMP    LMUL
97D6      C3 00 90                        JMP    LDIV
97D9      C3 60 90                        JMP    LSUB
97DC      C3 CE 91                        JMP    DFXL
97DF      C3 57 91                        JMP    LMCM
97E2      C3 FF 94                        JMP    COPY
97E5      C3 9A 93                        JMP    CVRT
97E8      C3 1E 95                        JMP    INPUT
97EB      C3 6E 96                        JMP    MULT
97EE      C3 44 96                        JMP    PTVAL
97F1      C3 37 96                        JMP    DCOMP
97F4      C3 64 96                        JMP    MCHK
97F7      C3 3D 96                        JMP    CHAR2
97FA      C3 93 89                        JMP    INL
97FD      C3 D6 87                        JMP    OUTL
                                          END
NO PROGRAM ERRORS

                          SYMBOL TABLE

 * 01

 A       0007      ABCH    9134      ACPR    92EF      ADD1    94DC
 ADD2    90DF      ADDZ    90D6      AORS    92E1      APLS    9552
 B       0000      BBCH    913D      BCHK    91E2      BCTL    938D
 BMIN    9122      C       0001      CCHK    9344      CCMP    925B
 CFCHE   924C      CHAR2   963D      COM1    9116      COM2    9128
 CONIN   0104      COPT    94F1      COPY    94FF      CRIN    904D
 CSIGN   9369      CSTR    9371      CTWO    94E0      CVRT    939A
 D       0002      DADD    9206      DCLR    921D      DCMP    92F4
 DCOMP   9637      DECPT   9583      DECR    92D4 *    DFXL    91CE
 DIGO    943A      DIVIT   94C3      DLST    91E9      DRST    91F8
 DSUB    9226      DTST2   9012      E       0003      ENT1    9310
 ENT2    930A      EP1     960C      EQ02    909C      EQUL    9094 *
 ERR     951C      FINIT   94D7      FINUP   94B7      FLOAT   91D5
```

```
FLTSG   9612      FXL1    91B2 *    FXL2    91B3      GCHAR   9241
GCHR    949D      GETA    949E      GETEX   94BE      GETN    9627
GNUM    95C9      GOON    903B      GOTV    93E5      H       0004
INCR    92B6      INCR2   92C6      INCR3   92C3      INDF1   9284 *
INDFC   92A8      INEXP   9598      INL     8993      INP     97FA
INPOP   9422      INPUT   951E      INT1    9574      INT5    955C
INTR    917F      KPGO    9176      L       0005      L000    9146
L001    9148      L002    911F      L003    914B      L128    914E
L129    9151      L131    9154      LADD    905C      LADS    9062
LASD    9102      LDCP    9339      LDIV    9000      LLTB    907F
LMCM    9157      LMCP    9340      LMUL    915F      LOOP    94E2
LSFT    9476      LSUB    9060      LXFR    9324      M       0006
MADD    91A4      MANT    90EF      MAXCH   003F      MCHK    9664
MCHK1   9665      MDGN    9400      MDSKP   940E      MINCH   00C0
MORD    94A3      MSFH    9379      MULT    966E      MULTT   944E
N1      964E      NCHK    9084      NNZRO   93AF      NORM    91AD
NORM1   91AE *    NOTO    90AA      NZRO    93CC      OFLW1   9276
OFLWC   935B      OK1     9409      OUTL    87D6      OUTR    97FD
OVER    9317      PLSV    9499      POPD    941F      PSW     0006
PTVAL   9644      REP3    9027      REP5    9326      REP6    91B9
SAVEN   9616      SCALE   9540      SCCFG   92D2      SCHAR   91CB
SH10    908C      SHIFT   968B      SIGN    9490      SP      0006
STATU   010A      STORC   9353      SUBZ    90B9      TEN     9518
TEN5    9514      TLOOP   9479      TLP2    947A      TOP     9676
TRY1    93F3      TRYP    95DF      TRYTN   956C      TST1    93F8
TST8    93D8      TSTEX   9533      TSTN    95E4      TSTR    92E7
TWOD    94C9      UFLW1   9268      UFLWC   9362      USEIT   95BA
WCHAR   929F      WFLT    0B57      WIND    927F      WMANT   9298
WOVR    9271      WUND    9263      WZER    928D      WZERC   92AF
ZCHK    91DA      ZMCHK   91DA      ZROIT   962D

* 02

* 03

* 04
```

Chapter 2

Dr. Wang's Palo Alto Tiny Basic

By Roger Rauskolb

Tiny Basic was first proposed in Dr. Dobb's Journal. Li-Chen Wang's version of Palo Alto Tiny Basic originally appeared in Issue No. 5, May 1976 of Dr. Dobb's Journal. A complete listing was printed, but Dr. Wang did the assembly on an IBM computer and he defined different mnemonics. In order to assemble with an Intel Compatible Assembler a translation of most mnemonics had to be performed.

I had developed my own system, which consists of two small p.c. boards, one containing the 8080 CPU, 4k of 2708 type EROM and 1K of RAM. The other PCB contained the RS-232 Interface using the Intel 8251. So I wanted to change the I/O section.

If you want to change I/O, all routines are contained in the OUTC and CHKIO routines. My system uses the following configuration:

2708	EROMS	0000H	TO	07FFH
1k	OF RAM	1000H	TO	13FFH
8251	DATA PORT	0FAH		
8251	STATUS PORT			

Command Instruction 27H = 2 stop bits parity disabled.
8 bit characters.
Baud Rate Factor of 04.

Mode Instruction 0CFH = No Hunt Mode. Not (RTS) forced to 0. Receive Enabled Data Terminal Ready Transmit Enabled.

Transmitter Ready Status Bit = Bit 0 (01H)
Receiver Buffer Ready Status Bit = Bit 1 (02H)

The program is contained in locations 0000H to 0768H.

In 1K of RAM 847 bytes are left over for program.

Tiny Basic does not offer much in terms of functions and general mathematical capabilities. But it is great to teach programming basic to children (and adults) and for games, since it has the RND function. It takes up little memory space and executes a lot faster than other basics.

Dr. Wang was very helpful and assisted me all the way. Some errors were eliminated. I appreciate his help and he deserves a lot of credit for his implementation of Tiny Basic.

THE TINY BASIC LANGUAGE

Numbers

In Tiny Basic, all numbers are integers and must be less than or equal to 32767.

Variables

There are 26 variables denoted by letters A through Z. There is also a single array @(1). The dimension of this array (i.e., the range of value of the index 1) is set automatically to make use of all the memory space that is left unused by the program. (i.e., 0 through SIZE/2, see SIZE function below.)

Functions

For the time being, there are only 3 functions:

ABS(X) gives the absolute value of X.
RND(X) gives a random number between 1 and X (inclusive).
SIZE gives the number of bytes left unused by the program.

Arithmetic and Compare Operators

/ divide. Note that since we have integers only, $\frac{2}{3} = 0$.
* multiply.
− subtract.
+ add.
> compare if greater than.
< compare if less than.
= compare if equal to. Note than to certain versions of Basic "LET A = B = O" means "set both A and B to O." To this version of Tiny Basic, it means "set A to the result of comparing B with O."
# compare if not equal to.
>= compare if greater than or equal to.
<= compare if less than or equal to.

+, −, *, and / operations result in a value of between −32767 and 32767. All compare operators result in a 1 if true and a 0 if not true.

Expressions

Expressions are formed with numbers, variables, and functions with arithmetic and compare operators between them. + and − signs can also be used at the beginning of an expression. The value of an expression is evaluated from left to right, except that * and / are always done first, and then + and –, and then compare operators. Parentheses can also be used to alter the order of evaluation.

Statements

A Tiny Basic statement consists of a statement number between 1 and 32767 followed by one or more commands. Commands in the same statement are separated by a semi-colon ";". "GOTO", "STOP", and "RETURN" commands must be the last command in any given statement.

Program

A Tiny Basic program consists of one or more statements. When a direct command "RUN" is issued, the statement with the lowest statement number is executed first, then the one with the next lowest statement number, etc. However, the "GOTO", "GOSUB", "STOP", and "RETURN" commands can alter this normal sequence. Within the statement, execution of the commands is from left to right. The "IF" command can cause the execution of all the commands to its right in the same statement to be skipped over.

Commands

Tiny Basic commands are listed below with examples. Remember that commands can be concatenated with semi-colons. In order to store the statement, you must also have a statement number in front of the commands. The statement number and the concatenation are not shown in the examples.

REM or REMARK Command

```
REM anything goes
```

This line will be ignored by TBI.

LET Command

```
LET A = 234 – 5*6, A = A/2, X = A – 100, @(X + 9) = A – 1
```

will set the variable A to the value of the expression 234 – 5*6 (i.e., 204), set the variable A (again) to the value of the expression A/2 (i.e., 102), set the variable X to the value of the expression A-100 (i.e., 2), and then set the variable @(11) to 101 (where 11 is the value of the expression X + 9 and 101 is the value of the expression A – 1).

```
LET U = A#B, V = (A>B)*X + (A<B)*Y
```

will set the variable U to either 1 or 0 depending on whether A is not equal to or is equal to B; and set the variable V to either X, Y or 0 depending on whether A is greater than, less than, or equal to B.

PRINT Command

```
PRINT
```

will cause a carriage-return (CR) and a line-feed (LF) on the output device.

```
PRINT A*3 + 1,“ABC 123 !@#”,‘CBA’
```

will print the value of the expression A*3 + 1 (i.e., 307), the string of characters “ABC 123 !@#”, and the string “CBA”, and then a CR-LF. Note that either single or double quotes can be used to quote strings, but pairs must be matched.

```
PRINT A*3 + 1,“ABC 123 !@#”,‘CBA’,
```

will produce the same output as before, except that there is no CR-LF after the last item is printed. This enables the program to continue printing on the same line with another “PRINT”.

```
PRINT A, B, #3, C, D, E, #10, F, G
```

will print the values of A and B in 6 spaces, the values of C, D, and E in 3 spaces, and the values of F and G in 10 spaces. If there are not enough spaces specified for a given value to be printed, the value will be printed with enough spaces anyway.

```
PRINT ‘ABC’,←,‘XXX’
```

will print the string “ABC”, a CR without a LF, and then the string “XXX” (over the ABC) followed by a CR-LF.

INPUT Command

```
INPUT A,B
```

When this command is executed, Tiny Basic will print “A:” and wait to read in an expression from the input device. The variable A will be set to the value of this expression. Then “B:” is printed and variable B is set to the value of the next expression read from the input device. Note that not only numbers, but also expressions can be read as input.

```
INPUT ‘WHAT IS THE WEIGHT’A, “AND SIZE”B
```

This is the same as the command above, except the prompt “A:” is replaced by “WHAT IS THE WEIGHT:” and the prompt “B:” is replaced by “AND SIZE:”. Again, both single and double quotes can be used as long as they are matched.

```
INPUT A, ‘STRING’,←,“ANOTHER STRING”,B
```

the strings and the “←” have the same effect as in “PRINT”.

IF Command

```
IF A<B LET X=3; PRINT ‘THIS STRING’
```

will test the value of the expression A<B. If it is not zero (i.e., if it is true), the commands in the rest of this statement will be executed. If the value of the expression is zero (i.e., if it is not true), the rest of this statement will be skipped over and execution continues at next statement. Note that the word “THEN” is not used.

GOTO Command

GOTO 120

will cause the execution to jump to statement 120. Note that GOTO command cannot be followed by a semi-colon and other commands. It must be ended with a CR.

GOTO A*10+B

will cause the execution to jump to a different statement number as computed from the value of the expression.

GOSUB and RETURN Commands

GOSUB command is similar to GOTO command except that: a) the current statement number and position within the statement is remembered; and b) a semi-colon and other commands can follow it in the same statement.

GOSUB 120

will cause the execution to jump to statement 120.

GOSUB A*10+B

will cause the execution to jump to different statements as computed from the value of the expression a*10+B.

RETURN

A RETURN command must be the last command in a statement and followed by a CR. When a RETURN command is encountered, it will cause the execution to jump back to the command following the most recent GOSUB command.

GOSUB can be nested. The depth of nesting is limited only by the stack space.

LIST

will print out all the statements in numerical order.

LIST 120

will print out all the statements in numerical order 120.

NEW

will delete all the statements.

Stopping the Execution

The execution of program or listing of program can be stopped by the Control-C key on the input device.

Abbreviation and blanks

You may use blanks freely, except that numbers, command key words, and function names can not have embedded blanks.

You can truncate all command key words and function names and follow each by a period. "P.", "PR.", "PRI.", and "PRIN." all stand for "PRINT." Also the word LET in LET command can be omitted. The "shortest" abbreviation for all the key words are as follows:

A. = ABS F. = FOR GOS. = GOSUB G. = GOTO
IF = IF IN. = INPUT L. = LIST N. = NEW
N. = NEXT P. = PRINT REM. = REMARK R. = RETURN
R. = RND R. = RUN S. = SIZE S. = STEP
S. = STOP TO = TO
Implied = LET

Control of Output Device

The Control-O key on the input device can be used to turn the output device ON and OFF. This is useful when you want to read in a program punched on paper tape.

To produce such a paper tape, type "LIST" without CR. Turn on the paper tape punch and type a few Control-Shift-P's and then a CR. When listing is finished, type more Control-Shift-P's and turn off the punch.

To read back such a paper tape, type "NEW," CR, and Control-O, then turn on the paper tape reader. When the paper tape is finished, turn it off and type a Control-O again.

Control-Shift-P's and turn off the punch

To read back such a paper tape, type "NEW," CR, and Control-?, then turn on the paper tape reader. When the paper tape is finished, turn it off and type a Control-O, then turn on the paper tape reader. When the paper tape is finished, turn it off and type a Control-O again.

Error Report

There are only three error conditions in TINY BASIC. The statement with the error is printed out with a question mark inserted at the point where the error is detected.

(1) WHAT? means it does not understand you. Example:

WHAT? 210 P?TINT "THIS" where PRINT is mistyped

WHAT? 260 LET A = B + 3, C = (3 + 4), X = 4

(2) HOW? means it understands you but does not know how to do it.

HOW? 310LET A = B*C? + 2 where B*C is larger than 32767

HOW? 380 GOTO 412? where 412 does not exist

(3) SORRY means it understands you and knows how to do it but there is not enough memory to do it.

Error Corrections

If you notice an error in typing before you hit the CR, you can delete the last character by the Rub-Out key or delete the entire line by the Alt-Mode key. Tiny basic will echo a back-slash for each Rub-Out. Echo for Alt-Mode consists of a LF, a CR, and an up-arrow.

To correct a statement, you can retype the statement number and the correct commands. Tiny Basic will replace the old statement with the new one.

To delete a statement, type the statement number and a CR only.

Verify the corrections by "LIST nnnn" and hit the Control-C key while the line is being printed.

FOR and NEXT Commands

FOR X = A + 1 TO 3*B STEP C-1

The variable X is set to the value of the expression A + 1. The values of the expressions (not the expressions themselves) 3*B and C-1 are remembered. The name of the variable X, the statement number and the position of this command within the statement are also remembered. Execution then continues the normal way until a NEXT command is encountered.

The STEP can be positive, negative or even zero. The word STEP and the expression following it can be omitted if the desired STEP is +1.

NEXT X

The name of the variable (X) is checked with that of the most recent FOR command. If they do not agree, that FOR is terminated and the next recent FOR is checked, etc. When a match is found, this variable will be set to its current value plus the value of the STEP expression saved by the FOR command. The updated value is then compared with the value of the TO expression also saved by the FOR command. If this is within the limit, execution will jump back to the command following the FOR command. If this is outside the limit, execution continues following the NEXT command itself.

FOR can be nested. The depth of nesting is limited only by the stack space. If a new FOR command with the same control variable as that of an old FOR command is encountered, the old FOR will be terminated automatically.

STOP Command

STOP

This command stops the execution of the program and returns control to direct commands from the input device. It can appear many times in a program but must be the last command in any given statement, i.e., it cannot be followed by semi-colon and other commands.

Direct Commands

As defined earlier, a statement consists of a statement number followed by commands. IF the statement number is missing, or if it is 0, the commands will be executed after you have typed the CR. All the commands described above can be used as direct commands. There are three more commands that can be used as direct command but not as part of a statement:

RUN

will start to execute the program starting at the lowest statement number.

```
CP/M MACRO ASSEM 2.0    #001    TINY BASIC FOR INTEL 8080

                ;************************************************************
                ;*
                        TITLE   'TINY BASIC FOR INTEL 8080'
                ;*                      VERSION 1.0
                ;*                      BY LI-CHEN WANG
                ;*                      10 JUNE, 1976
                ;*                      @COPYLEFT
                ;*                      ALL WRONGS RESERVED
                ;*
                ;************************************************************
                ;*
                ;*      ;*** ZERO PAGE SUBROUTINES ***
                ;*
                ;*  THE 8080 INSTRUCTION SET LETS YOU HAVE 8 ROUTINES IN LOW
                ;*  MEMORY THAT MAY BE CALLED BY RST N, N BEING 0 THROUGH 7.
                ;*  THIS IS A ONE-BYTE INSTRUCTION AND HAS THE SAME POWER AS
                ;*  THE THREE-BYTE INSTRUCTION CALL  LLHH.  TINY BASIC WILL
                ;*  USE RST 0 AS START AND RST 1 THROUGH RST 7 FOR
                ;*  THE SEVEN MOST FREQUENTLY USED SUBROUTINES.
                ;*  TWO OTHER SUBROUTINES (CRLF AND TSTNUM) ARE ALSO IN THIS
                ;*  SECTION.  THEY CAN BE REACHED ONLY BY 3-BYTE CALLS.
                ;*  IN ORDER TO CONFIGURE THE SYSTEM FOR USE WITH CPM I HAVE
                ;*  MOVED SOME OF THE ROUTINES AROUND.  START WILL NOW BE AT
                ;*  LOCATION 100H AND THIS SECTION WILL END AT LOCATION 3FH
                ;*  WITH A JUMP TO 108H.
                ;*
                ;       ORG     8H
                ;       XTHL            ;*** TSTC OR RST 1 ***
                ;       RST     5       ;IGNORE BLANKS AND
                ;       CMP     M       ;TEST CHARACTER
                ;       JMP     TC1     ;REST OF THIS IS AT TC1
                ;*
                ;CRLF   MVI     A,0DH   ;*** CRLF ***
                ;*
                ;       PUSH    PSW     ;*** OUTC OR RST 2 ***
                ;       LDA     OCSW    ;PRINT CHARACTER ONLY
                ;       ORA     A       ;IFF OCSW SWITCH IS ON
                ;       JMP     OC2     ;REST OF THIS IS AT OC2
                ;*
                ;       CALL    EXPR2   ;*** EXPR OR RST 3 ***
                ;       PUSH    H       ;EVALUATE AN EXPRESION
                ;       JMP     EXPR1   ;REST OF IT IS AT EXPR1
                ;       DB      'W'
                ;*
                ;       MOV     A,H     ;*** COMP OR RST 4 ***
                ;       CMP     D       ;COMPARE HL WITH DE
                ;       RNZ             ;RETURN CORRECT C AND
                ;       MOV     A,L     ;Z FLAGS
                ;       CMP     E       ;BUT OLD A IS LOST
                ;       RET
                ;       DB      'AN'
                ;*
                ;SS1    LDAX    D       ;*** IGNBLK/RST 5 ***
                ;       CPI     40Q     ;IGNORE BLANKS
                ;       RNZ             ;IN TEXT (WHERE DE->)
                ;       INX     D       ;AND RETURN THE FIRST
                ;       JMP     SS1     ;NON-BLANK CHAR. IN A
                ;*
                ;       POP     PSW     ;*** FINISH/RST 6 ***
                ;       CALL    FIN     ;CHECK END OF COMMAND
                ;       JMP     QWHAT   ;PRINT 'WHAT?' IFF WRONG
                ;       DB      'G'
                ;*
                ;       RST     5       ;*** TSTV OR RST 7 ***
                ;       SUI     100Q    ;TEST VARIABLES
                ;       RC              ;C:NOT A VARIABLE
                ;       JMP     TSTV1   ;JUMP AROUND RESERVED AREA
 0100                   ORG     100H    ;OF CPM.
 0100 C3A00A    START   JMP     NINIT   ;GO TO INITIALIZATION ROUTINE.  JIF
 0103 C21F01    TSTV1   JNZ     TV1     ;NOT '@' ARRAY
 0106 13                INX     D       ;IT IS THE '@' ARRAY
 0107 CDBC06            CALL    PARN    ;@ SHOULD BE FOLLOWED
 010A 29                DAD     H       ;BY (EXPR) AS ITS INDEX
 010B DA6601            JC      QHOW    ;IS INDEX TOO BIG?
 010E D5                PUSH    D       ;WILL IT OVERWRITE
 010F EB                XCHG            ;TEXT?
 0110 CDFE06            CALL    SIZE    ;FIND SIZE OF FREE
 0113 E7                RST     4       ;AND CHECK THAT
 0114 DA0E08            JC      ASORRY  ;IFF SO, SAY 'SORRY'
 0117 21000F    SS1A    LXI     H,VARBGN ;IFF NOT, GET ADDRESS
```

```
011A CD9C07             CALL    SUBDE   ;OF @(EXPR) AND PUT IT
011D D1                 POP     D       ;IN HL
011E C9                 RET             ;C FLAG IS CLEARED
011F FE1B       TV1     CPI     33Q     ;NOT @, IS IT A TO Z?
0121 3F                 CMC             ;IFF NOT RETURN C FLAG
0122 D8                 RC
0123 13                 INX     D       ;IFF A THROUGH Z
0124 21000F     TV1A    LXI     H,VARBGN ;COMPUTE ADDRESS OF
0127 07                 RLC             ;THAT VARIABLE
0128 85                 ADD     L       ;AND RETURN IT IN HL
0129 6F                 MOV     L,A     ;WITH C FLAG CLEARED
012A 3E00               MVI     A,0
012C 8C                 ADC     H
012D 67                 MOV     H,A
012E C9                 RET
                ;*
                ;*       TSTC   XCH     HL,(SP) ;*** TSTC OR RST 1 ***
                ;*              IGNBLK   THIS IS AT LOC. 8
                ;*              CMP     M       AND THEN JMP HERE
012F 23         TC1     INX     H       ;COMPARE THE BYTE THAT
0130 CA3A01             JZ      TC2     ;FOLLOWS THE RST INST.
0133 C5                 PUSH    B       ;WITH THE TEXT (DE->)
0134 4E                 MOV     C,M     ;IFF NOT =, ADD THE 2ND
0135 0600               MVI     B,0     ;BYTE THAT FOLLOWS THE
0137 09                 DAD     B       ;RST TO THE OLD PC
0138 C1                 POP     B       ;I.E., DO A RELATIVE
0139 1B                 DCX     D       ;JUMP IFF NOT =
013A 13         TC2     INX     D       ;IFF =, SKIP THOSE BYTES
013B 23                 INX     H       ;AND CONTINUE
013C E3                 XTHL
013D C9                 RET
                ;*
013E 210000     TSTNUM  LXI     H,0     ;*** TSTNUM ***
0141 44                 MOV     B,H     ;TEST IFF THE TEXT IS
0142 EF                 RST     5       ;A NUMBER
0143 FE30       TN1     CPI     60Q     ;IFF NOT, RETURN 0 IN
0145 D8                 RC              ;B AND HL
0146 FE3A               CPI     72Q     ;IFF NUMBERS, CONVERT
0148 D0                 RNC             ;TO BINARY IN HL AND
0149 3EF0               MVI     A,360Q  ;SET A TO # OF DIGITS
014B A4                 ANA     H       ;IFF H>255, THERE IS NO
014C C26601             JNZ     QHOW    ;ROOM FOR NEXT DIGIT
014F 04                 INR     B       ;B COUNTS # OF DIGITS
0150 C5                 PUSH    B
0151 44                 MOV     B,H     ;HL=10;*HL+(NEW DIGIT)
0152 4D                 MOV     C,L
0153 29                 DAD     H       ;WHERE 10;* IS DONE BY
0154 29                 DAD     H       ;SHIFT AND ADD
0155 09                 DAD     B
0156 29                 DAD     H
0157 1A                 LDAX    D       ;AND (DIGIT) IS FROM
0158 13                 INX     D       ;STRIPPING THE ASCII
0159 E60F               ANI     17Q     ;CODE
015B 85                 ADD     L
015C 6F                 MOV     L,A
015D 3E00               MVI     A,0
015F 8C                 ADC     H
0160 67                 MOV     H,A
0161 C1                 POP     B
0162 1A                 LDAX    D       ;DO THIS DIGIT AFTER
0163 F24301             JP      TN1     ;DIGIT. S SAYS OVERFLOW
0166 D5         QHOW    PUSH    D       ;*** ERROR: "HOW?" ***
0167 116D01     AHOW    LXI     D,HOW
016A C3E407             JMP     ERROR
016D 484F573F0DHOW      DB      'HOW?',0DH
0172 4F4B0D     OK      DB      'OK',0DH
0175 574841543FWHAT     DB      'WHAT?',0DH
017B 534F525259SORRY    DB      'SORRY',0DH
                ;*
                ;**************************************************************
                ;*
                ;* *** MAIN ***
                ;*
                ;* THIS IS THE MAIN LOOP THAT COLLECTS THE TINY BASIC PROGRAM
                ;* AND STORES IT IN THE MEMORY.
                ;*
                ;* AT START, IT PRINTS OUT "(CR)OK(CR)", AND INITIALIZES THE
                ;* STACK AND SOME OTHER INTERNAL VARIABLES. THEN IT PROMPTS
                ;* ">" AND READS A LINE. IFF THE LINE STARTS WITH A NON-ZERO
                ;* NUMBER, THIS NUMBER IS THE LINE NUMBER. THE LINE NUMBER
                ;* (IN 16 BIT BINARY) AND THE REST OF THE LINE (INCLUDING CR)
                ;* IS STORED IN THE MEMORY. IFF A LINE WITH THE SAME LINE
```

```
                 ;* NUMBER IS ALREDY THERE, IT IS REPLACED BY THE NEW ONE. IF
                 ;* THE REST OF THE LINE CONSISTS OF A ODHONLY, IT IS NOT STORED
                 ;* AND ANY EXISTING LINE WITH THE SAME LINE NUMBER IS DELETED.
                 ;*
                 ;* AFTER A LINE IS INSERTED, REPLACED, OR DELETED, THE PROGRAM
                 ;* LOOPS BACK AND ASK FOR ANOTHER LINE. THIS LOOP WILL BE
                 ;* TERMINATED WHEN IT READS A LINE WITH ZERO OR NO LINE
                 ;* NUMBER; AND CONTROL IS TRANSFERED TO 'DIRCT'.
                 ;*
                 ;* TINY BASIC PROGRAM SAVE AREA STARTS AT THE MEMORY LOCATION
                 ;* LABELED 'TXTBGN' AND ENDED AT 'TXTEND'. WE ALWAYS FILL THIS
                 ;* AREA STARTING AT 'TXTBGN', THE UNFILLED PORTION IS POINTED
                 ;* BY THE CONTENT OF A MEMORY LOCATION LABELED 'TXTUNF'.
                 ;*
                 ;* THE MEMORY LOCATION 'CURRNT' POINTS TO THE LINE NUMBER
                 ;* THAT IS CURRENTLY BEING INTERPRETED. WHILE WE ARE IN
                 ;* THIS LOOP OR WHILE WE ARE INTERPRETING A DIRECT COMMAND
                 ;* (SEE NEXT SECTION), 'CURRNT' SHOULD POINT TO A 0.
                 ;*
0181 310020      RSTART  LXI     SP,STACK ;SET STACK POINTER
0184 CD0E00      ST1     CALL    CRLF     ;AND JUMP TO HERE
0187 117201              LXI     D,OK     ;DE->STRING
018A 97                  SUB     A        ;A=0
018B CD7F08              CALL    PRTSTG   ;PRINT STRING UNTIL ODH
018E 219501              LXI     H,ST2+1  ;LITERAL 0
0191 22C109              SHLD    CURRNT   ;CURRNT->LINE # = 0
0194 210000      ST2     LXI     H,0
0197 22C909              SHLD    LOPVAR
019A 22C309              SHLD    STKGOS
019D 3E3E        ST3     MVI     A,76Q    ;PROMPT '>' AND
019F CD1408              CALL    GETLN    ;READ A LINE
01A2 D5                  PUSH    D        ;DE->END OF LINE
01A3 11370F      ST3A    LXI     D,BUFFER ;DE->BEGINNING OF LINE
01A6 CD3E01              CALL    TSTNUM   ;TEST IFF IT IS A NUMBER
01A9 EF                  RST     5
01AA 7C                  MOV     A,H      ;HL=VALUE OF THE # OR
01AB B5                  ORA     L        ;0 IFF NO # WAS FOUND
01AC C1                  POP     B        ;BC->END OF LINE
01AD CAD502              JZ      DIRECT
01B0 1B                  DCX     D        ;BACKUP DE AND SAVE
01B1 7C                  MOV     A,H      ;VALUE OF LINE # THERE
01B2 12                  STAX    D
01B3 1B                  DCX     D
01B4 7D                  MOV     A,L
01B5 12                  STAX    D
01B6 C5                  PUSH    B        ;BC,DE->BEGIN, END
01B7 D5                  PUSH    D
01B8 79                  MOV     A,C
01B9 93                  SUB     E
01BA F5                  PUSH    PSW      ;A=# OF BYTES IN LINE
01BB CD5708              CALL    FNDLN    ;FIND THIS LINE IN SAVE
01BE D5                  PUSH    D        ;AREA, DE->SAVE AREA
01BF C2D201              JNZ     ST4      ;NZ:NOT FOUND, INSERT
01C2 D5                  PUSH    D        ;Z:FOUND, DELETE IT
01C3 CD7308              CALL    FNDNXT   ;FIND NEXT LINE
                 ;*      DE->NEXT LINE
01C6 C1                  POP     B        ;BC->LINE TO BE DELETED
01C7 2AD509              LHLD    TXTUNF   ;HL->UNFILLED SAVE AREA
01CA CD0009              CALL    MVUP     ;MOVE UP TO DELETE
01CD 60                  MOV     H,B      ;TXTUNF->UNFILLED AREA
01CE 69                  MOV     L,C
01CF 22D509              SHLD    TXTUNF   ;UPDATE
01D2 C1          ST4     POP     B        ;GET READY TO INSERT
01D3 2AD509              LHLD    TXTUNF   ;BUT FIRT CHECK IF
01D6 F1                  POP     PSW      ;THE LENGTH OF NEW LINE
01D7 E5                  PUSH    H        ;IS 3 (LINE # AND CR)
01D8 FE03                CPI     3        ;THEN DO NOT INSERT
01DA CA8101              JZ      RSTART   ;MUST CLEAR THE STACK
01DD 85                  ADD     L        ;COMPUTE NEW TXTUNF
01DE 6F                  MOV     L,A
01DF 3E00                MVI     A,0
01E1 8C                  ADC     H
01E2 67                  MOV     H,A      ;HL->NEW UNFILLED AREA
01E3 11000F      ST4A    LXI     D,TXTEND ;CHECK TO SEE IF THERE
01E6 E7                  RST     4        ;IS ENOUGH SPACE
01E7 D20D08              JNC     QSORRY   ;SORRY, NO ROOM FOR IT
01EA 22D509              SHLD    TXTUNF   ;OK, UPDATE TXTUNF
01ED D1                  POP     D        ;DE->OLD UNFILLED AREA
01EE CD0909              CALL    MVDOWN
01F1 D1                  POP     D        ;DE->BEGIN, HL->END
01F2 E1                  POP     H
01F3 CD0009              CALL    MVUP     ;MOVE NEW LINE TO SAVE
01F6 C39D01              JMP     ST3      ;AREA
```

```
                    ;*
                    ;**************************************************************
                    ;*
                    ;* *** TABLES *** DIRECT *** & EXEC ***
                    ;*
                    ;* THIS SECTION OF THE CODE TESTS A STRING AGAINST A TABLE.
                    ;* WHEN A MATCH IS FOUND, CONTROL IS TRANSFERED TO THE SECTION
                    ;* OF CODE ACCORDING TO THE TABLE.
                    ;*
                    ;* AT 'EXEC', DE SHOULD POINT TO THE STRING AD HL SHOULD POINT
                    ;* TO THE TABLE-1. AT 'DIRECT', DE SHOULD POINT TO THE STRING,
                    ;* HL WILL BE SET UP TO POINT TO TAB1-1, WHICH IS THE TABLE OF
                    ;* ALL DIRECT AND STATEMENT COMMANDS.
                    ;*
                    ;* A '.' IN THE STRING WILL TERMINATE THE TEST AND THE PARTIAL
                    ;* MATCH WILL BE CONSIDERED AS A MATCH. E.G., 'P.', 'PR.',
                    ;* 'PRI.', 'PRIN.', OR 'PRINT' WILL ALL MATCH 'PRINT'.
                    ;*
                    ;* THE TABLE CONSISTS OF ANY NUMBER OF ITEMS. EACH ITEM
                    ;* IS A STRING OF CHARACTERS WITH BIT 7 SET TO 0 AND
                    ;* A JUMP ADDRESS STORED HI-LOW WITH BIT 7 OF THE HIGH
                    ;* BYTE SET TO 1.
                    ;*
                    ;* END OF TABLE IS AN ITEM WITH A JUMP ADDRESS ONLY. IFF THE
                    ;* STRING DOES NOT MATCH ANY OF THE OTHER ITEMS, IT WILL
                    ;* MATCH THIS NULL ITEM AS DEFAULT.
                    ;*
01F9 =              TAB1    EQU     $       ;DIRECT COMMANDS
01F9 4C495354               DB      'LIST'
01FD 8420                   DB      LIST SHR 8 + 128,LIST AND OFFH
01FF 52554E                 DB      'RUN'
0202 8315                   DB      RUN SHR 8 + 128,RUN AND 255
0204 4E4557                 DB      'NEW'
0207 8306                   DB      NEW SHR 8 + 128,NEW AND 255
0209 4C4F4144               DB      'LOAD'
020D 8343                   DB      DLOAD SHR 8 + 128,DLOAD AND 255
020F 53415645               DB      'SAVE'
0213 838A                   DB      DSAVE SHR 8 + 128,DSAVE AND 255
0215 4259458000             DB      'BYE',80H,0H    ;GO BACK TO CPM
021A =              TAB2    EQU     $       ;DIRECT/TATEMENT
021A 4E455854               DB      'NEXT'
021E 8508                   DB      NEXT SHR 8 + 128,NEXT AND 255
0220 4C4554                 DB      'LET'
0223 85C8                   DB      LET SHR 8 + 128,LET AND 255
0225 4F5554                 DB      'OUT'
0228 870B                   DB      OUTCMD SHR 8 + 128,OUTCMD AND 255
022A 504F4B45               DB      'POKE'
022E 8747                   DB      POKE SHR 8 + 128,POKE AND 255
0230 57414954               DB      'WAIT'
0234 871F                   DB      WAITCM SHR 8 + 128,WAITCM AND 255
0236 4946                   DB      'IF'
0238 8559                   DB      IFF SHR 8 + 128,IFF AND 255
023A 474F544F               DB      'GOTO'
023E 8334                   DB      GOTO SHR 8 + 128,GOTO AND 255
0240 474F535542             DB      'GOSUB'
0245 8470                   DB      GOSUB SHR 8 + 128,GOSUB AND 255
0247 5245545552             DB      'RETURN'
024D 8490                   DB      RETURN SHR 8 + 128,RETURN AND 255
024F 52454D                 DB      'REM'
0252 8555                   DB      REM SHR 8 + 128,REM AND 255
0254 464F52                 DB      'FOR'
0257 84A9                   DB      FOR SHR 8 + 128,FOR AND 255
0259 494E505554             DB      'INPUT'
025E 8572                   DB      INPUT SHR 8 + 128,INPUT AND 255
0260 5052494E54             DB      'PRINT'
0265 8438                   DB      PRINT SHR 8 + 128,PRINT AND 255
0267 53544F50               DB      'STOP'
026B 830F                   DB      STOP SHR 8 + 128,STOP AND 255
026D 85C2                   DB      DEFLT SHR 8 + 128,DEFLT AND 255
026F 594F552043             DB      'YOU CAN ADD MORE';COMMANDS BUT
                                    ;REMEMBER TO MOVE DEFAULT DOWN.
027F =              TAB4    EQU     $       ;FUNCTIONS
027F 524E44                 DB      'RND'
0282 86C7                   DB      RND SHR 8 + 128,RND AND 255
0284 494E50                 DB      'INP'
0287 8738                   DB      INP SHR 8 + 128,INP AND 255
0289 5045454B               DB      'PEEK'
028D 8757                   DB      PEEK SHR 8 + 128,PEEK AND 255
028F 555352                 DB      'USR'
0292 8761                   DB      USR SHR 8 + 128,USR AND 255
0294 414253                 DB      'ABS'
0297 86F2                   DB      ABS SHR 8 + 128,ABS AND 255
```

```
0299 53495A45          DB      'SIZE'
029D 86FE              DB      SIZE SHR 8 + 128,SIZE AND 255
029F 86AD              DB      XP40 SHR 8 + 128,XP40 AND 255
02A1 594F552043        DB      'YOU CAN ADD MORE';FUNCTIONS BUT REMEMBER
                                         ;TO MOVE XP40 DOWN
02B1 =         TAB5    EQU     $         ;'TO' IN 'FOR'
02B1 544F              DB      'TO'
02B3 84B9              DB      FR1 SHR 8 + 128,FR1 AND 255
02B5 87E0              DB      QWHAT SHR 8 + 128,QWHAT AND 255
02B7 =         TAB6    EQU     $         ;'STEP' IN 'FOR'
02B7 53544550          DB      'STEP'
02BB 84C3              DB      FR2 SHR 8 + 128,FR2 AND 255
02BD 84C7              DB      FR3 SHR 8 + 128,FR3 AND 255
02BF =         TAB8    EQU     $         ;RELATION OPERATORS
02BF 3E3D              DB      '>='
02C1 85D8              DB      XP11 SHR 8 + 128,XP11 AND 255
02C3 23                DB      '#'
02C4 85DE              DB      XP12 SHR 8 + 128,XP12 AND 255
02C6 3E                DB      '>'
02C7 85E4              DB      XP13 SHR 8 + 128,XP13 AND 255
02C9 3D                DB      '='
02CA 85F3              DB      XP15 SHR 8 + 128,XP15 AND 255
02CC 3C3D              DB      '<='
02CE 85EB              DB      XP14 SHR 8 + 128,XP14 AND 255
02D0 3C                DB      '<'
02D1 85F9              DB      XP16 SHR 8 + 128,XP16 AND 255
02D3 85FF              DB      XP17 SHR 8 + 128,XP17 AND 255
               ;*
02D5 21F801    DIRECT  LXI     H,TAB1-1          ;*** DIRECT ***
               ;*
02D8 =         EXEC    EQU     $         ;*** EXEC ***
02D8 EF        EX0     RST     5         ;IGNORE LEADING BLANKS
02D9 D5                PUSH    D         ;SAVE POINTER
02DA 1A        EX1     LDAX    D         ;IFF FOUND '.' IN STRING
02DB 13                INX     D         ;BEFORE ANY MISMATCH
02DC FE2E              CPI     56Q       ;WE DECLARE A MATCH
02DE CAF702            JZ      EX3
02E1 23                INX     H         ;HL->TABLE
02E2 BE                CMP     M         ;IFF MATCH, TEST NEXT
02E3 CADA02            JZ      EX1
02E6 3E7F              MVI     A,177Q    ;ELSE, SEE IFF BIT 7
02E8 1B                DCX     D         ;OF TABLEIS SET, WHICH
02E9 BE                CMP     M         ;IS THE JUMP ADDR. (HI)
02EA DAFE02            JC      EX5       ;C:YES, MATCHED
02ED 23        EX2     INX     H         ;NC:NO, FIND JUMP ADDR.
02EE BE                CMP     M
02EF D2ED02            JNC     EX2
02F2 23                INX     H         ;BUMP TO NEXT TAB. ITEM
02F3 D1                POP     D         ;RESTORE STRING POINTER
02F4 C3D802            JMP     EX0       ;TEST AGAINST NEXT ITEM
02F7 3E7F      EX3     MVI     A,177Q    ;PARTIAL MATCH, FIND
02F9 23        EX4     INX     H         ;JUMP ADDR., WHICH IS
02FA BE                CMP     M         ;FLAGGED BY BIT 7
02FB D2F902            JNC     EX4
02FE 7E        EX5     MOV     A,M       ;LOAD HL WITH THE JUMP
02FF 23                INX     H         ;ADDRESS FROM THE TABLE
0300 6E                MOV     L,M
0301 E67F              ANI     177Q      ;MASK OFF BIT 7
0303 67                MOV     H,A
0304 F1                POP     PSW       ;CLEAN UP THE GABAGE
0305 E9                PCHL              ;AND WE GO DO IT
               ;*
               ;***************************************************************
               ;*
               ;* WHAT FOLLOWS IS THE CODE TO EXECUTE DIRECT AND STATEMENT
               ;* COMMANDS. CONTROL IS TRANSFERED TO THESE POINTS VIA THE
               ;* COMMAND TABLE LOOKUP CODE OF 'DIRECT' AND 'EXEC' IN LAST
               ;* SECTION. AFTER THE COMMAND IS EXECUTED, CONTROL IS
               ;* TANSFERED TO OTHER SECTIONS AS FOLLOWS:
               ;*
               ;* FOR 'LIST', 'NEW', AND 'STOP': GO BACK TO 'RSTART'
               ;* FOR 'RUN': GO EXECUTE THE FIRST STORED LINE IFF ANY; ELSE
               ;* GO BACK TO 'RSTART'.
               ;* FOR 'GOTO' AND 'GOSUB': GO EXECUTE THE TARGET LINE.
               ;* FOR 'RETURN' AND 'NEXT': GO BACK TO SAVED RETURN LINE.
               ;* FOR ALL OTHERS: IFF 'CURRNT' -> 0, GO TO 'RSTART', ELSE
               ;* GO EXECUTE NEXT COMMAND. (THIS IS DONE IN 'FINISH'.)
               ;*
               ;***************************************************************
               ;*
               ;* *** NEW *** STOP *** RUN (& FRIENDS) *** & GOTO ***
               ;*
```

```
                ;* 'NEW(CR)' SETS 'TXTUNF' TO POINT TO 'TXTBGN'
                ;*
                ;* 'STOP(CR)' GOES BACK TO 'RSTART'
                ;*
                ;* 'RUN(CR)' FINDS THE FIRST STORED LINE, STORE ITS ADDRESS (IN
                ;* 'CURRNT'), AND START EXECUTE IT. NOTE THAT ONLY THOSE
                ;* COMMANDS IN TAB2 ARE LEGAL FOR STORED PROGRAM.
                ;*
                ;* THERE ARE 3 MORE ENTRIES IN 'RUN':
                ;* 'RUNNXL' FINDS NEXT LINE, STORES ITS ADDR. AND EXECUTES IT.
                ;* 'RUNTSL' STORES THE ADDRESS OF THIS LINE AND EXECUTES IT.
                ;* 'RUNSML' CONTINUES THE EXECUTION ON SAME LINE.;*
                ;* 'GOTO EXPR(CR)' EVALUATES THE EXPRESSION, FIND THE TARGET
                ;* LINE, AND JUMP TO 'RUNTSL' TO DO IT.
                ;* 'DLOAD' LOADS A NAMED PROGRAM FROM DISK.
                ;* 'DSAVE' SAVES A NAMED PROGRAM ON DISK.
                ;* 'FCBSET' SETS UP THE FILE CONTROL BLOCK FOR SUBSEQUENT DISK I/O
                ;*
0306 CDDC07     NEW     CALL    ENDCHK  ;*** NEW(CR) ***
0309 21D709             LXI     H,TXTBGN
030C 22D509             SHLD    TXTUNF
                ;*
030F CDDC07     STOP    CALL    ENDCHK  ;*** STOP(CR) ***
0312 C38101             JMP     RSTART
                ;*
0315 CDDC07     RUN     CALL    ENDCHK  ;*** RUN(CR) ***
0318 11D709             LXI     D,TXTBGN ;FIRST SAVED LINE
                ;*
031B 210000     RUNNXL  LXI     H,0     ;*** RUNNXL ***
031E CD5F08             CALL    FNDLNP  ;FIND WHATEVER LINE #
0321 DA8101             JC      RSTART  ;C:PASSED TXTUNF, QUIT
                ;*
0324 EB         RUNTSL  XCHG            ;*** RUNTSL ***
0325 22C109             SHLD    CURRNT  ;SET 'CURRNT'->LINE #
0328 EB                 XCHG
0329 13                 INX     D       ;BUMP PASS LINE #
032A 13                 INX     D
                ;*
032B CD8509     RUNSML  CALL    CHKIO   ;*** RUNSML ***
032E 211902             LXI     H,TAB2-1 ;FIND COMMAND IN TAB2
0331 C3D802             JMP     EXEC    ;AND EXECUTE IT
                ;*
0334 DF         GOTO    RST     3       ;*** GOTO EXPR ***
0335 D5                 PUSH    D       ;SAVE FOR ERROR ROUTINE
0336 CDDC07             CALL    ENDCHK  ;MUST FIND A 0DH
0339 CD5708             CALL    FNDLN   ;FIND THE TARGET LINE
033C C26701             JNZ     AHOW    ;NO SUCH LINE #
033F F1                 POP     PSW     ;CLEAR THE 'PUSH  DE'
0340 C32403             JMP     RUNTSL  ;GO DO IT
0005 =          CPM     EQU     5       ;DISK PARAMETERS
005C =          FCB     EQU     5CH
001A =          SETDMA  EQU     26
000F =          OPEN    EQU     15
0014 =          READD   EQU     20
0015 =          WRITED  EQU     21
0010 =          CLOSE   EQU     16
0016 =          MAKE    EQU     22
0013 =          DELETE  EQU     19
                ;*
0343 EF         DLOAD   RST     5       ;IGNORE BLANKS
0344 E5                 PUSH    H       ;SAVE H
0345 CDE503             CALL    FCBSET  ;SET UP FILE CONTROL BLOCK
0348 D5                 PUSH    D       ;SAVE THE REST
0349 C5                 PUSH    B
034A 115C00             LXI     D,FCB   ;GET FCB ADDRESS
034D 0E0F               MVI     C,OPEN  ;PREPARE TO OPEN FILE
034F CD0500             CALL    CPM     ;OPEN IT
0352 FEFF               CPI     0FFH    ;IS IT THERE?
0354 CA6601             JZ      QHOW    ;NO, SEND ERROR
0357 AF                 XRA     A       ;CLEAR A
0358 327C00             STA     FCB+32  ;START AT RECORD 0
035B 11D509             LXI     D,TXTUNF ;GET BEGINNING
035E D5         LOAD    PUSH    D       ;SAVE DMA ADDRESS
035F 0E1A               MVI     C,SETDMA        ;
0361 CD0500             CALL    CPM     ;SET DMA ADDRESS
0364 0E14               MVI     C,READD ;
0366 115C00             LXI     D,FCB
0369 CD0500             CALL    CPM     ;READ SECTOR
036C FE01               CPI     1       ;DONE?
036E DA8103             JC      RDMORE  ;NO, READ MORE
0371 C26601             JNZ     QHOW    ;BAD READ
```

```
0374 0E10                MVI     C,CLOSE
0376 115C00              LXI     D,FCB
0379 CD0500              CALL    CPM      ;CLOSE FILE
037C D1                  POP     D        ;THROW AWAY DMA ADD.
037D C1                  POP     B        ;GET OLD REGISTERS BACK
037E D1                  POP     D
037F E1                  POP     H
0380 F7                  RST     6        ;FINISH
0381 D1        RDMORE    POP     D        ;GET DMA ADDRESS
0382 218000              LXI     H,80H    ;GET 128
0385 19                  DAD     D        ;ADD 128 TO DMA ADD.
0386 EB                  XCHG             ;PUT IT BACK IN D
0387 C35E03              JMP     LOAD     ;AND READ SOME MORE
               ;*
038A EF        DSAVE     RST     5        ;IGNORE BLANKS
038B E5                  PUSH    H        ;SAVE H
038C CDE503              CALL    FCBSET   ;SETUP FCB
038F D5                  PUSH    D
0390 C5                  PUSH    B        ;SAVE OTHERS
0391 115C00              LXI     D,FCB
0394 0E13                MVI     C,DELETE
0396 CD0500              CALL    CPM      ;ERASE FILE IF IT EXISTS
0399 115C00              LXI     D,FCB
039C 0E16                MVI     C,MAKE
039E CD0500              CALL    CPM      ;MAKE A NEW ONE
03A1 FEFF                CPI     OFFH     ;IS THERE SPACE?
03A3 CA6601              JZ      QHOW     ;NO, ERROR
03A6 AF                  XRA     A        ;CLEAR A
03A7 327C00              STA     FCB+32   ;START AT RECORD 0
03AA 11D509              LXI     D,TXTUNF  ;GET BEGINNING
03AD D5        SAVE      PUSH    D        ;SAVE DMA ADDRESS
03AE 0E1A                MVI     C,SETDMA         ;
03B0 CD0500              CALL    CPM      ;SET DMA ADDRESS
03B3 0E15                MVI     C,WRITED
03B5 115C00              LXI     D,FCB
03B8 CD0500              CALL    CPM      ;WRITE SECTOR
03BB B7                  ORA     A        ;SET FLAGS
03BC C26601              JNZ     QHOW     ;IF NOT ZERO, ERROR
03BF D1                  POP     D        ;GET DMA ADD. BACK
03C0 3AD609              LDA     TXTUNF+1 ;AND MSB OF LAST ADD.
03C3 BA                  CMP     D        ;IS D SMALLER?
03C4 DAD903              JC      SAVDON   ;YES, DONE
03C7 C2D103              JNZ     WRITMOR ;DONT TEST E IF NOT EQUAL
03CA 3AD509              LDA     TXTUNF   ;IS E SMALLER?
03CD BB                  CMP     E
03CE DAD903              JC      SAVDON   ;YES, DONE
03D1 218000    WRITMOR   LXI     H,80H
03D4 19                  DAD     D        ;ADD 128 TO DMA ADD.
03D5 EB                  XCHG             ;GET IT BACK IN D
03D6 C3AD03              JMP     SAVE     ;WRITE SOME MORE
03D9 0E10      SAVDON    MVI     C,CLOSE
03DB 115C00              LXI     D,FCB
03DE CD0500              CALL    CPM      ;CLOSE FILE
03E1 C1                  POP     B        ;GET REGISTERS BACK
03E2 D1                  POP     D
03E3 E1                  POP     H
03E4 F7                  RST     6        ;FINISH
               ;*
03E5 215C00    FCBSET    LXI     H,FCB    ;GET FILE CONTROL BLOCK ADDRESS
03E8 3600                MVI     M,0      ;CLEAR ENTRY TYPE
03EA 23        FNCLR     INX     H        ;NEXT LOCATION
03EB 3620                MVI     M,' '    ;CLEAR TO SPACE
03ED 3E64                MVI     A,FCB+8 AND 255
03EF BD                  CMP     L        ;DONE?
03F0 C2EA03              JNZ     FNCLR    ;NO, DO IT AGAIN
03F3 23                  INX     H        ;NEXT
03F4 3654                MVI     M,'T'    ;SET FILE TYPE TO 'TBI'
03F6 23                  INX     H
03F7 3642                MVI     M,'B'
03F9 23                  INX     H
03FA 3649                MVI     M,'I'
03FC 23        EXRC      INX     H        ;CLEAR REST OF FCB
03FD 3600                MVI     M,0
03FF 3E6B                MVI     A,FCB+15 AND 255
0401 BD                  CMP     L        ;DONE?
0402 C2FC03              JNZ     EXRC     ;NO, CONTINUE
0405 215D00              LXI     H,FCB+1 ;GET FILENAME START
0408 1A        FN        LDAX    D        ;GET CHARACTER
0409 FE0D                CPI     0DH      ;IS IT A 'CR'
040B C8                  RZ               ;YES, DONE
040C FE21                CPI     '!'      ;LEGAL CHARACTER?
040E DAE007              JC      QWHAT    ;NO, SEND ERROR
```

```
0411 FE5B               CPI     'C'     ;AGAIN
0413 D2E007             JNC     QWHAT   ;DITTO
0416 77                 MOV     M,A     ;SAVE IT IN FCB
0417 23                 INX     H       ;NEXT
0418 13                 INX     D
0419 3E65               MVI     A,FCB+9 AND 255
041B BD                 CMP     L       ;LAST?
041C C20804             JNZ     FN      ;NO, CONTINUE
041F C9                 RET             ;TRUNCATE AT 8 CHARACTERS
                ;*
                ;**************************************************************
                ;*
                ;* *** LIST *** & PRINT ***
                ;*
                ;* LIST HAS TWO FORMS:
                ;* 'LIST(CR)' LISTS ALL SAVED LINES
                ;* 'LIST #(CR)' START LIST AT THIS LINE #
                ;* YOU CAN STOP THE LISTING BY CONTROL C KEY
                ;*
                ;* PRINT COMMAND IS 'PRINT ....;' OR 'PRINT ....(CR)'
                ;* WHERE '....' IS A LIST OF EXPRESIONS, FORMATS, BACK-
                ;* ARROWS, AND STRINGS. THESE ITEMS ARE SEPERATED BY COMMAS.
                ;*
                ;* A FORMAT IS A POUND SIGN FOLLOWED BY A NUMBER. IT CONTROLSS
                ;* THE NUMBER OF SPACES THE VALUE OF A EXPRESION IS GOING TO
                ;* BE PRINTED.  IT STAYS EFFECTIVE FOR THE REST OF THE PRINT
                ;* COMMAND UNLESS CHANGED BY ANOTHER FORMAT. IFF NO FORMAT IS
                ;* SPECIFIED, 6 POSITIONS WILL BE USED.
                ;*
                ;* A STRING IS QUOTED IN A PAIR OF SINGLE QUOTES OR A PAIR OF
                ;* DOUBLE QUOTES.
                ;*
                ;* A BACK-ARROW MEANS GENERATE A (CR) WITHOUT (LF)
                ;*
                ;* A (CRLF) IS GENERATED AFTER THE ENTIRE LIST HAS BEEN
                ;* PRINTED OR IFF THE LIST IS A NULL LIST. HOWEVER IFF THE LIST
                ;* ENDED WITH A COMMA, NO (CRL) IS GENERATED.
                ;*
0420 CD3E01     LIST    CALL    TSTNUM  ;TEST IFF THERE IS A #
0423 CDDC07             CALL    ENDCHK  ;IFF NO # WE GET A 0
0426 CD5708             CALL    FNDLN   ;FIND THIS OR NEXT LINE
0429 DA8101     LS1     JC      RSTART  ;C:PASSED TXTUNF
042C CDED08             CALL    PRTLN   ;PRINT THE LINE
042F CD8509             CALL    CHKIO   ;STOP IFF HIT CONTROL-C
0432 CD5F08             CALL    FNDLNP  ;FIND NEXT LINE
0435 C32904             JMP     LS1     ;AND LOOP BACK
                ;*
0438 0E06       PRINT   MVI     C,6     ;C = # OF SPACES
043A CF                 RST     1       ;IFF NULL LIST & ';'
043B 3B                 DB      73Q
043C 06                 DB      6Q
043D CD0E00             CALL    CRLF    ;GIVE CR-LF AND
0440 C32B03             JMP     RUNSML  ;CONTINUE SAME LINE
0443 CF         PR2     RST     1       ;IFF NULL LIST (CR)
0444 0D                 DB      0DH
0445 06                 DB      6Q
0446 CD0E00             CALL    CRLF    ;ALSO GIVE CR-LF AND
0449 C31B03             JMP     RUNNXL  ;GO TO NEXT LINE
044C CF         PR0     RST     1       ;ELSE IS IT FORMAT?
044D 23                 DB      '#'
044E 05                 DB      5Q
044F DF                 RST     3       ;YES, EVALUATE EXPR.
0450 4D                 MOV     C,L     ;AND SAVE IT IN C
0451 C35A04             JMP     PR3     ;LOOK FOR MORE TO PRINT
0454 CD8B08     PR1     CALL    QTSTG   ;OR IS IT A STRING?
0457 C36704             JMP     PR8     ;IFF NOT, MUST BE EXPR.
045A CF         PR3     RST     1       ;IFF ',', GO FIND NEXT
045B 2C                 DB      ','
045C 06                 DB      6Q
045D CDCD07             CALL    FIN     ;IN THE LIST.
0460 C34C04             JMP     PR0     ;LIST CONTINUES
0463 CD0E00     PR6     CALL    CRLF    ;LIST ENDS
0466 F7                 RST     6
0467 DF         PR8     RST     3       ;EVALUATE THE EXPR
0468 C5                 PUSH    B
0469 CDB108             CALL    PRTNUM  ;PRINT THE VALUE
046C C1                 POP     B
046D C35A04             JMP     PR3     ;MORE TO PRINT?
                ;*
                ;**************************************************************
                ;*
                ;* *** GOSUB *** & RETURN ***
                ;*
                ;* 'GOSUB EXPR;' OR 'GOSUB EXPR (CR)' IS LIKE THE 'GOTO'
                ;* COMMAND, EXCEPT THAT THE CURRENT TEXT POINTER, STACK POINTER
                ;* ETC. ARE SAVE SO THAT EXECUTION CAN BE CONTINUED AFTER THE
                ;* SUBROUTINE 'RETURN'. IN ORDER THAT 'GOSUB' CAN BE NESTED
                ;* (AND EVEN RECURSIVE), THE SAVE AREA MUST BE STACKED.
                ;* THE STACK POINTER IS SAVED IN 'STKGOS'. THE OLD 'STKGOS' IS
                ;* SAVED IN THE STACK.  IFF WE ARE IN THE MAIN ROUTINE, 'STKGOS
                ;* IS ZERO (THIS WAS DONE BY THE "MAIN" SECTION OF THE CODE),
                ;* BUT WE STILL SAVE IT AS A FLAG FOR NO FURTHER RETURNS.
                ;*
                ;* 'RETURN(CR)' UNDOS EVERYHING THAT 'GOSUB' DID, AND THUS
                ;* RETURN THE EXCUTION TO THE COMMAND AFTER THE MOST RECENT
                ;* 'GOSUB'. IFF 'STKGOS' IS ZERO, IT INDICATES THAT WE
                ;* NEVER HAD A 'GOSUB' AND IS THUS AN ERROR.
                ;*
0470 CD3409     GOSUB   CALL    PUSHA   ;SAVE THE CURRENT "FOR"
0473 DF                 RST     3       ;PARAMETERS
0474 D5                 PUSH    D       ;AND TEXT POINTER
0475 CD5708             CALL    FNDLN   ;FIND THE TARGET LINE
0478 C26701             JNZ     AHOW    ;NOT THERE. SAY "HOW?"
047B 2AC109             LHLD    CURRNT  ;FOUND IT, SAVE OLD
047E E5                 PUSH    H       ;'CURRNT' OLD 'STKGOS'
047F 2AC309             LHLD    STKGOS
0482 E5                 PUSH    H
0483 210000             LXI     H,0     ;AND LOAD NEW ONES
0486 22C909             SHLD    LOPVAR
0489 39                 DAD     SP
048A 22C309             SHLD    STKGOS
048D C32403             JMP     RUNTSL  ;THEN RUN THAT LINE
0490 CDDC07     RETURN  CALL    ENDCHK  ;THERE MUST BE A 0DH
0493 2AC309             LHLD    STKGOS  ;OLD STACK POINTER
0496 7C                 MOV     A,H     ;0 MEANS NOT EXIST
0497 B5                 ORA     L
0498 CAE007             JZ      QWHAT   ;SO, WE SAY: "WHAT?"
049B F9                 SPHL            ;ELSE, RESTORE IT
049C E1                 POP     H
049D 22C309             SHLD    STKGOS  ;AND THE OLD 'STKGOS'
04A0 E1                 POP     H
04A1 22C109             SHLD    CURRNT  ;AND THE OLD 'CURRNT'
04A4 D1                 POP     D       ;OLD TEXT POINTER
04A5 CD1809             CALL    POPA    ;OLD "FOR" PARAMETERS
04A8 F7                 RST     6       ;AND WE ARE BACK HOME
                ;*
                ;*************************************************************
                ;*
                ;* *** FOR *** & NEXT ***
                ;*
                ;* 'FOR' HAS TWO FORMS:
                ;* 'FOR VAR=EXP1 TO EXP2 STEP EXP1' AND 'FOR VAR=EXP1 TO EXP2'
                ;* THE SECOND FORM MEANS THE SAME THING AS THE FIRST FORM WITH
                ;* EXP1=1. (I.E., WITH A STEP OF +1.)
                ;* TBI WILL FIND THE VARIABLE VAR. AND SET ITS VALUE TO THE
                ;* CURRENT VALUE OF EXP1. IT ALSO EVALUATES EXPR2 AND EXP1
                ;* AND SAVE ALL THESE TOGETHER WITH THE TEXT POINTERR ETC. IN
                ;* THE 'FOR' SAVE AREA, WHICH CONSISTS OF 'LOPVAR', 'LOPINC',
                ;* 'LOPLMT', 'LOPLN', AND 'LOPPT'. IFF THERE IS ALREADY SOME-
                ;* THING IN THE SAVE AREA (THIS IS INDICATED BY A NON-ZERO
                ;* 'LOPVAR'), THEN THE OLD SAVE AREA IS SAVED IN THE STACK
                ;* BEFORE THE NEW ONE OVERWRITES IT.
                ;* TBI WILL THEN DIG IN THE STACK AND FIND OUT IFF THIS SAME
                ;* VARIABLE WAS USED IN ANOTHER CURRENTLY ACTIVE 'FOR' LOOP.
                ;* IFF THAT IS THE CASE THEN THE OLD 'FOR' LOOP IS DEACTIVATED.
                ;* (PURGED FROM THE STACK..)
                ;*
                ;* 'NEXT VAR' SERVES AS THE LOGICAL (NOT NECESSARILLY PHYSICAL)
                ;* END OF THE 'FOR' LOOP. THE CONTROL VARIABLE VAR. IS CHECKED
                ;* WITH THE 'LOPVAR'.   IFF THEY ARE NOT THE SAME, TBI DIGS IN
                ;* THE STACK TO FIND THE RIGHTT ONE AND PURGES ALL THOSE THAT
                ;* DID NOT MATCH. EITHER WAY, TBI THEN ADDS THE 'STEP' TO
                ;* THAT VARIABLE AND CHECK THE RESULT WITH THE LIMIT. IFF IT
                ;* IS WITHIN THE LIMIT, CONTROL LOOPS BACK TO THE COMMAND
                ;* FOLLOWING THE 'FOR'. IFF OUTSIDE THE LIMIT, THE SAVE ARER
                ;* IS PURGED AND EXECUTION CONTINUES.
                ;*
04A9 CD3409     FOR     CALL    PUSHA   ;SAVE THE OLD SAVE AREA
04AC CDBA07             CALL    SETVAL  ;SET THE CONTROL VAR.
04AF 2B                 DCX     H       ;HL IS ITS ADDRESS
04B0 22C909             SHLD    LOPVAR  ;SAVE THAT
04B3 21B002             LXI     H,TAB5-1 ;USE 'EXEC' TO LOOK
04B6 C3D802             JMP     EXEC    ;FOR THE WORD 'TO'
04B9 DF         FR1     RST     3       ;EVALUATE THE LIMIT
```

```
04BA 22CD09             SHLD    LOPLMT  ;SAVE THAT
04BD 21B602             LXI     H,TAB6-1 ;USE 'EXEC' TO LOOK
04C0 C3D802             JMP     EXEC    ;FOR THE WORD 'STEP'
04C3 DF         FR2     RST     3       ;FOUND IT, GET STEP
04C4 C3CA04             JMP     FR4
04C7 210100     FR3     LXI     H,1Q    ;NOT FOUND, SET TO 1
04CA 22CB09     FR4     SHLD    LOPINC  ;SAVE THAT TOO
04CD 2AC109     FR5     LHLD    CURRNT  ;SAVE CURRENT LINE #
04D0 22CF09             SHLD    LOPLN
04D3 EB                 XCHG            ;AND TEXT POINTER
04D4 22D109             SHLD    LOPPT
04D7 010A00             LXI     B,12Q   ;DIG INTO STACK TO
04DA 2AC909             LHLD    LOPVAR  ;FIND 'LOPVAR'
04DD EB                 XCHG
04DE 60                 MOV     H,B
04DF 68                 MOV     L,B     ;HL=0 NOW
04E0 39                 DAD     SP      ;HERE IS THE STACK
04E1 3E                 DB      76Q
04E2 09         FR7     DAD     B       ;EACH LEVEL IS 10 DEEP
04E3 7E                 MOV     A,M     ;GET THAT OLD 'LOPVAR'
04E4 23                 INX     H
04E5 B6                 ORA     M
04E6 CA0305             JZ      FR8     ;0 SAYS NO MORE IN IT
04E9 7E                 MOV     A,M
04EA 2B                 DCX     H
04EB BA                 CMP     D       ;SAME AS THIS ONE?
04EC C2E204             JNZ     FR7
04EF 7E                 MOV     A,M     ;THE OTHER HALF?
04F0 BB                 CMP     E
04F1 C2E204             JNZ     FR7
04F4 EB                 XCHG            ;YES, FOUND ONE
04F5 210000             LXI     H,0
04F8 39                 DAD     SP      ;TRY TO MOVE SP
04F9 44                 MOV     B,H
04FA 4D                 MOV     C,L
04FB 210A00             LXI     H,12Q
04FE 19                 DAD     D
04FF CD0909             CALL    MVDOWN  ;AND PURGE 10 WORDS
0502 F9                 SPHL            ;IN THE STACK
0503 2AD109     FR8     LHLD    LOPPT   ;JOB DONE, RESTORE DE
0506 EB                 XCHG
0507 F7                 RST     6       ;AND CONTINUE
                ;*
0508 FF         NEXT    RST     7       ;GET ADDRESS OF VAR.
0509 DAE007             JC      QWHAT   ;NO VARIABLE, "WHAT?"
050C 22C509             SHLD    VARNXT  ;YES, SAVE IT
050F D5         NX0     PUSH    D       ;SAVE TEXT POINTER
0510 EB                 XCHG
0511 2AC909             LHLD    LOPVAR  ;GET VAR. IN 'FOR'
0514 7C                 MOV     A,H
0515 B5                 ORA     L       ;0 SAYS NEVER HAD ONE
0516 CAE107             JZ      AWHAT   ;SO WE ASK: "WHAT?"
0519 E7                 RST     4       ;ELSE WE CHECK THEM
051A CA2705             JZ      NX3     ;OK, THEY AGREE
051D D1                 POP     D       ;NO, LET'S SEE
051E CD1809             CALL    POPA    ;PURGE CURRENT LOOP
0521 2AC509             LHLD    VARNXT  ;AND POP ONE LEVEL
0524 C30F05             JMP     NX0     ;GO CHECK AGAIN
0527 5E         NX3     MOV     E,M     ;COME HERE WHEN AGREED
0528 23                 INX     H
0529 56                 MOV     D,M     ;DE=VALUE OF VAR.
052A 2ACB09             LHLD    LOPINC
052D E5                 PUSH    H
052E 19                 DAD     D       ;ADD ONE STEP
052F EB                 XCHG
0530 2AC909             LHLD    LOPVAR  ;PUT IT BACK
0533 73                 MOV     M,E
0534 23                 INX     H
0535 72                 MOV     M,D
0536 2ACD09             LHLD    LOPLMT  ;HL->LIMIT
0539 F1                 POP     PSW     ;OLD HL
053A B7                 ORA     A
053B F23F05             JP      NX1     ;STEP > 0
053E EB                 XCHG
053F CDB207     NX1     CALL    CKHLDE  ;COMPARE WITH LIMIT
0542 D1                 POP     D       ;RESTORE TEXT POINTER
0543 DA5105             JC      NX2     ;OUTSIDE LIMIT
0546 2ACF09             LHLD    LOPLN   ;WITHIN LIMIT, GO
0549 22C109             SHLD    CURRNT  ;BACK TO THE SAVED
054C 2AD109             LHLD    LOPPT   ;'CURRNT' AND TEXT
054F EB                 XCHG            ;POINTER
0550 F7                 RST     6
```

```
0551 CD1809     NX2     CALL    POPA      ;PURGE THIS LOOP
0554 F7                 RST     6
                ;*
                ;**********************************************************
                ;*
                ;* *** REM *** IFF *** INPUT *** & LET (& DEFLT) ***
                ;*
                ;* 'REM' CAN BE FOLLOWED BY ANYTHING AND IS IGNORED BY TBI.
                ;* TBI TREATS IT LIKE AN 'IF' WITH A FALSE CONDITION.
                ;*
                ;* 'IF' IS FOLLOWED BY AN EXPR. AS A CONDITION AND ONE OR MORE
                ;* COMMANDS (INCLUDING OUTHER 'IF'S) SEPERATED BY SEMI-COLONS.
                ;* NOTE THAT THE WORD 'THEN' IS NOT USED. TBI EVALUATES THE
                ;* EXPR. IFF IT IS NON-ZERO, EXECUTION CONTINUES. IFF THE
                ;* EXPR. IS ZERO, THE COMMANDS THAT FOLLOWS ARE IGNORED AND
                ;* EXECUTION CONTINUES AT THE NEXT LINE.
                ;*
                ;* 'IPUT' COMMAND IS LIKE THE 'PRINT' COMMAND, AND IS FOLLOWED
                ;* BY A LIST OF ITEMS.  IFF THE ITEM IS A STRING IN SINGLE OR
                ;* DOUBLE QUOTES, OR IS A BACK-ARROW, IT HAS THE SAME EFFECT AS
                ;* IN 'PRINT'.  IFF AN ITEM IS A VARIABLE, THIS VARIABLE NAME IS
                ;* PRINTED OUT FOLLOWED BY A COLON. THEN TBI WAITS FOR AN
                ;* EXPR. TO BE TYPED IN. THE VARIABLE ISS THEN SET TO THE
                ;* VALUE OF THIS EXPR.  IFF THE VARIABLE IS PROCEDED BY A STRING
                ;* (AGAIN IN SINGLE OR DOUBLE QUOTES), THE STRING WILL BE
                ;* PRINTED FOLLOWED BY A COLON. TBI THEN WAITS FOR INPUT EXPR.
                ;* AND SET THE VARIABLE TO THE VALUE OF THE EXPR.
                ;*
                ;* IFF THE INPUT EXPR. IS INVALID, TBI WILL PRINT "WHAT?",
                ;* "HOW?" OR "SORRY" AND REPRINT THE PROMPT AND REDO THE INPUT.
                ;* THE EXECUTION WILL NOT TERMINATE UNLESS YOU TYPE CONTROL-C.
                ;* THIS IS HANDLED IN 'INPERR'.
                ;*
                ;* 'LET' IS FOLLOWED BY A LIST OF ITEMS SEPERATED BY COMMAS.
                ;* EACH ITEM CONSISTS OF A VARIABLE, AN EQUAL SIGN, AND AN EXPR.
                ;* TBI EVALUATES THE EXPR. AND SET THE VARIBLE TO THAT VALUE.
                ;* TB WILL ALSO HANDLE 'LET' COMMAND WITHOUT THE WORD 'LET'.
                ;* THIS IS DONE BY 'DEFLT'.
                ;*
0555 210000     REM     LXI     H,0Q      ;*** REM ***
0558 3E                 DB      76Q
                ;*
0559 DF         IFF     RST     3         ;***'IFF ***
055A 7C                 MOV     A,H       ;IS THE EXPR.=0?
055B B5                 ORA     L
055C C22B03             JNZ     RUNSML    ;NO, CONTINUE
055F CD7508             CALL    FNDSKP    ;YES, SKIP REST OF LINE
0562 D22403             JNC     RUNTSL
0565 C38101             JMP     RSTART
                ;*
0568 2AC709     INPERR  LHLD    STKINP    ;*** INPERR ***
056B F9                 SPHL              ;RESTORE OLD SP
056C E1                 POP     H         ;AND OLD 'CURRNT'
056D 22C109             SHLD    CURRNT
0570 D1                 POP     D         ;AND OLD TEXT POINTER
0571 D1                 POP     D         ;REDO INPUT
                ;*
0572 =          INPUT   EQU     $         ;*** INPUT ***
0572 D5         IP1     PUSH    D         ;SAVE IN CASE OF ERROR
0573 CD8B08             CALL    QTSTG     ;IS NEXT ITEM A STRING?
0576 C38005             JMP     IP2       ;NO
0579 FF                 RST     7         ;YES. BUT FOLLOWED BY A
057A DABA05             JC      IP4       ;VARIABLE?     NO.
057D C39005             JMP     IP3       ;YES.   INPUT VARIABLE
0580 D5         IP2     PUSH    D         ;SAVE FOR 'PRTSTG'
0581 FF                 RST     7         ;MUST BE VARIABLE NOW
0582 DAE007             JC      QWHAT     ;"WHAT?" IT IS NOT?
0585 1A                 LDAX    D         ;GET READY FOR 'RTSTG'
0586 4F                 MOV     C,A
0587 97                 SUB     A
0588 12                 STAX    D
0589 D1                 POP     D
058A CD7F08             CALL    PRTSTG    ;PRINT STRING AS PROMPT
058D 79                 MOV     A,C       ;RESTORE TEXT
058E 1B                 DCX     D
058F 12                 STAX    D
0590 D5         IP3     PUSH    D         ;SAVE IN CASE OF ERROR
0591 EB                 XCHG
0592 2AC109             LHLD    CURRNT    ;ALSO SAVE 'CURRNT'
0595 E5                 PUSH    H
0596 217205             LXI     H,IP1     ;A NEGATIVE NUMBER
0599 22C109             SHLD    CURRNT    ;AS A FLAG
```

```
059C 210000             LXI     H,0Q    ;SAVE SP TOO
059F 39                 DAD     SP
05A0 22C709             SHLD    STKINP
05A3 D5                 PUSH    D       ;OLD HL
05A4 3E3A               MVI     A,72Q   ;PRINT THIS TOO
05A6 CD1408             CALL    GETLN   ;AND GET A LINE
05A9 11370F     IP3A    LXI     D,BUFFER ;POINTS TO BUFFER
05AC DF                 RST     3       ;EVALUATE INPUT
05AD 00                 NOP             ;CAN BE 'CALL   ENDCHK'
05AE 00                 NOP
05AF 00                 NOP
05B0 D1                 POP     D       ;OK, GET OLD HL
05B1 EB                 XCHG
05B2 73                 MOV     M,E     ;SAVE VALUE IN VAR.
05B3 23                 INX     H
05B4 72                 MOV     M,D
05B5 E1                 POP     H       ;GET OLD 'CURRNT'
05B6 22C109             SHLD    CURRNT
05B9 D1                 POP     D       ;AND OLD TEXT POINTER
05BA F1         IP4     POP     PSW     ;PURGE JUNK IN STACK
05BB CF                 RST     1       ;IS NEXT CH. ','?
05BC 2C                 DB      ','
05BD 03                 DB      3Q
05BE C37205             JMP     IP1     ;YES, MORE ITEMS.
05C1 F7         IP5     RST     6
                ;*
05C2 1A         DEFLT   LDAX    D       ;*** DEFLT ***
05C3 FE0D               CPI     0DH     ;EMPTY LINE IS OK
05C5 CAD105             JZ      LT1     ;ELSE IT IS 'LET'
                ;*
05C8 CDBA07     LET     CALL    SETVAL  ;*** LET ***
05CB CF                 RST     1       ;SET VALUE TO VAR.
05CC 2C                 DB      ','
05CD 03                 DB      3Q
05CE C3C805             JMP     LET     ;ITEM BY ITEM
05D1 F7         LT1     RST     6       ;UNTIL FINISH
                ;*
                ;**************************************************************
                ;*
                ;* *** EXPR ***
                ;*
                ;* 'EXPR' EVALUATES ARITHMETICAL OR LOGICAL EXPRESSIONS.
                ;* <EXPR>::=<EXPR2>
                ;*                      <EXPR2><REL.OP.><EXPR2>
                ;* WHERE <REL.OP.> IS ONE OF THE OPERATORSS IN TAB8 AND THE
                ;* RESULT OF THESE OPERATIONS IS 1 IFF TRUE AND 0 IFF FALSE.
                ;* <EXPR2>::=(+ OR -)<EXPR3>(+ OR -<EXPR3>)(....)
                ;* WHERE () ARE OPTIONAL AND (....) ARE OPTIONAL REPEATS.
                ;* <EXPR3>::=<EXPR4>(<* OR /><EXPR4>)(....)
                ;* <EXPR4>::=<VARIABLE>
                ;*                      <FUNCTION>
                ;*                      (<EXPR>)
                ;* <EXPR> IS RECURSIVE SO THAT VARIABLE '@' CAN HAVE AN <EXPR>
                ;* AS INDEX, FNCTIONS CAN HAVE AN <EXPR> AS ARGUMENTS, AND
                ;* <EXPR4> CAN BE AN <EXPR> IN PARANTHESE.
                ;*
                ;*      EXPR    CALL EXPR2      THIS IS AT LOC. 18
                ;*              PUSH    HL              SAVE <EXPR2> VALUE
05D2 21BE02     EXPR1   LXI     H,TAB8-1        ;LOOKUP REL.OP.
05D5 C3D802             JMP     EXEC    ;GO DO IT
05D8 CD0106     XP11    CALL    XP18    ;REL.OP.">="
05DB D8                 RC              ;NO, RETURN HL=0
05DC 6F                 MOV     L,A     ;YES, RETURN HL=1
05DD C9                 RET
05DE CD0106     XP12    CALL    XP18    ;REL.OP."#"
05E1 C8                 RZ              ;FALSE, RETURN HL=0
05E2 6F                 MOV     L,A     ;TRUE, RETURN HL=1
05E3 C9                 RET
05E4 CD0106     XP13    CALL    XP18    ;REL.OP.">"
05E7 C8                 RZ              ;FALSE
05E8 D8                 RC              ;ALSO FALSE, HL=0
05E9 6F                 MOV     L,A     ;TRUE, HL=1
05EA C9                 RET
05EB CD0106     XP14    CALL    XP18    ;REL.OP."<="
05EE 6F                 MOV     L,A     ;SET HL=1
05EF C8                 RZ              ;REL. TRUE, RETURN
05F0 D8                 RC
05F1 6C                 MOV     L,H     ;ELSE SET HL=0
05F2 C9                 RET
05F3 CD0106     XP15    CALL    XP18    ;REL.OP."="
05F6 C0                 RNZ             ;FALSE, RETRUN HL=0
05F7 6F                 MOV     L,A     ;ELSE SET HL=1
```

```
05F8 C9                 RET
05F9 CD0106    XP16     CALL    XP18       ;REL.OP.'<'
05FC D0                 RNC                ;FALSE, RETURN HL=0
05FD 6F                 MOV     L,A        ;ELSE SET HL=1
05FE C9                 RET
05FF E1        XP17     POP     H           ;NOT REL.OP.
0600 C9                 RET                ;RETURN HL=<EXPR2>
0601 79        XP18     MOV     A,C        ;SUBROUTINE FOR ALL
0602 E1                 POP     H          ;REL.OP.'S
0603 C1                 POP     B
0604 E5                 PUSH    H          ;REVERSE TOP OF STACK
0605 C5                 PUSH    B
0606 4F                 MOV     C,A
0607 CD1606             CALL    EXPR2      ;GET 2ND <EXPR2>
060A EB                 XCHG               ;VALUE IN DE NOW
060B E3                 XTHL               ;1ST <EXPR2> IN HL
060C CDB207             CALL    CKHLDE     ;COMPARE 1ST WITH 2ND
060F D1                 POP     D           ;RESTORE TEXT POINTER
0610 210000             LXI     H,0Q       ;SET HL=0, A=1
0613 3E01               MVI     A,1
0615 C9                 RET
               ;*
0616 CF        EXPR2    RST     1          ;NEGATIVE SIGN?
0617 2D                 DB      '-'
0618 06                 DB      6Q
0619 210000             LXI     H,0Q       ;YES, FAKE '0-'
061C C34006             JMP     XP26       ;TREAT LIKE SUBTRACT
061F CF        XP21     RST     1          ;POSITIVE SIGN? IGNORE
0620 2B                 DB      '+'
0621 00                 DB      0Q
0622 CD4A06    XP22     CALL    EXPR3      ;1ST <EXPR3>
0625 CF        XP23     RST     1          ;ADD?
0626 2B                 DB      '+'
0627 15                 DB      25Q
0628 E5                 PUSH    H          ;YES, SAVE VALUE
0629 CD4A06             CALL    EXPR3      ;GET 2ND<EXPR3>
062C EB        XP24     XCHG               ;2ND IN DE
062D E3                 XTHL               ;1ST IN HL
062E 7C                 MOV     A,H        ;COMPARE SIGN
062F AA                 XRA     D
0630 7A                 MOV     A,D
0631 19                 DAD     D
0632 D1                 POP     D          ;RESTORE TEXT POINTER
0633 FA2506             JM      XP23       ;1ST 2ND SIGN DIFFER
0636 AC                 XRA     H          ;1ST 2ND SIGN EQUAL
0637 F22506             JP      XP23       ;SO ISP RESULT
063A C36601             JMP     QHOW       ;ELSE WE HAVE OVERFLOW
063D CF        XP25     RST     1          ;SUBTRACT?
063E 2D                 DB      '-'
063F 83                 DB      203Q
0640 E5        XP26     PUSH    H          ;YES, SAVE 1ST <EXPR3>
0641 CD4A06             CALL    EXPR3      ;GET 2ND <EXPR3>
0644 CDA607             CALL    CHGSGN     ;NEGATE
0647 C32C06             JMP     XP24       ;AND ADD THEM
               ;*
064A CDA706    EXPR3    CALL    EXPR4      ;GET 1ST <EXPR4>
064D CF        XP31     RST     1          ;MULTIPLY?
064E 2A                 DB      '*'
064F 2C                 DB      54Q
0650 E5                 PUSH    H          ;YES, SAVE 1ST
0651 CDA706             CALL    EXPR4      ;AND GET 2ND <EXPR4>
0654 0600               MVI     B,0Q       ;CLEAR B FOR SIGN
0656 CDA307             CALL    CHKSGN     ;CHECK SIGN
0659 EB                 XCHG               ;2ND IN DE NOW
065A E3                 XTHL               ;1ST IN HL
065B CDA307             CALL    CHKSGN     ;CHECK SIGN OF 1ST
065E 7C                 MOV     A,H        ;IS HL > 255 ?
065F B7                 ORA     A
0660 CA6906             JZ      XP32       ;NO
0663 7A                 MOV     A,D        ;YES, HOW ABOUT DE
0664 B2                 ORA     D
0665 EB                 XCHG               ;PUT SMALLER IN HL
0666 C26701             JNZ     AHOW       ;ALSO >, WILL OVERFLOW
0669 7D        XP32     MOV     A,L        ;THIS IS DUMB
066A 210000             LXI     H,0Q       ;CLEAR RESULT
066D B7                 ORA     A          ;ADD AND COUNT
066E CA9906             JZ      XP35
0671 19        XP33     DAD     D
0672 DA6701             JC      AHOW       ;OVERFLOW
0675 3D                 DCR     A
0676 C27106             JNZ     XP33
0679 C39906             JMP     XP35       ;FINISHED
```

```
067C CF         XP34    RST     1       ;DIVIDE?
067D 2F                 DB      '/'
067E 44                 DB      104Q
067F E5                 PUSH    H       ;YES, SAVE 1ST <EXPR4>
0680 CDA706             CALL    EXPR4   ;AND GET 2ND ONE
0683 0600               MVI     B,0Q    ;CLEAR B FOR SIGN
0685 CDA307             CALL    CHKSGN  ;CHECK SIGN OF 2ND
0688 EB                 XCHG            ;PUT 2ND IN DE
0689 E3                 XTHL            ;GET 1ST IN HL
068A CDA307             CALL    CHKSGN  ;CHECK SIGN OF 1ST
068D 7A                 MOV     A,D     ;DIVIDE BY 0?
068E B3                 ORA     E
068F CA6701             JZ      AHOW    ;SAY "HOW?"
0692 C5                 PUSH    B       ;ELSE SAVE SIGN
0693 CD8607             CALL    DIVIDE  ;USE SUBROUTINE
0696 60                 MOV     H,B     ;RESULT IN HL NOW
0697 69                 MOV     L,C
0698 C1                 POP     B       ;GET SIGN BACK
0699 D1         XP35    POP     D       ;AND TEXT POINTER
069A 7C                 MOV     A,H     ;HL MUST BE +
069B B7                 ORA     A
069C FA6601             JM      QHOW    ;ELSE IT IS OVERFLOW
069F 78                 MOV     A,B
06A0 B7                 ORA     A
06A1 FCA607             CM      CHGSGN  ;CHANGE SIGN IFF NEEDED
06A4 C34D06             JMP     XP31    ;LOOK OR MORE TERMS
                ;*
06A7 217E02     EXPR4   LXI     H,TAB4-1  ;FIND FUNCTION IN TAB4
06AA C3D802             JMP     EXEC    ;AND GO DO IT
06AD FF         XP40    RST     7       ;NO, NOT A FUNCTION
06AE DAB606             JC      XP41    ;NOR A VARIABLE
06B1 7E                 MOV     A,M     ;VARIABLE
06B2 23                 INX     H
06B3 66                 MOV     H,M     ;VALUE IN HL
06B4 6F                 MOV     L,A
06B5 C9                 RET
06B6 CD3E01     XP41    CALL    TSTNUM  ;OR IS IT A NUMBER
06B9 78                 MOV     A,B     ;# OF DIGIT
06BA B7                 ORA     A
06BB C0                 RNZ             ;OK
06BC CF         PARN    RST     1       ;NO DIGIT, MUST BE
06BD 28                 DB      '('
06BE 05                 DB      5Q
06BF DF                 RST     3        ;"(EXPR)"
06C0 CF                 RST     1
06C1 29                 DB      ')'
06C2 01                 DB      1Q
06C3 C9         XP42    RET
06C4 C3E007     XP43    JMP     QWHAT   ;ELSE SAY: "WHAT?"
                ;*
06C7 CDBC06     RND     CALL    PARN    ;*** RND(EXPR) ***
06CA 7C                 MOV     A,H     ;EXPR MUST BE +
06CB B7                 ORA     A
06CC FA6601             JM      QHOW
06CF B5                 ORA     L       ;AND NON-ZERO
06D0 CA6601             JZ      QHOW
06D3 D5                 PUSH    D       ;SAVE BOTH
06D4 E5                 PUSH    H
06D5 2AD309             LHLD    RANPNT  ;GET MEMORY AS RANDOM
06D8 11B009             LXI     D,LSTROM        ;NUMBER
06DB E7                 RST     4
06DC DAE206             JC      RA1     ;WRAP AROUND IFF LAST
06DF 210001             LXI     H,START
06E2 5E         RA1     MOV     E,M
06E3 23                 INX     H
06E4 56                 MOV     D,M
06E5 22D309             SHLD    RANPNT
06E8 E1                 POP     H
06E9 EB                 XCHG
06EA C5                 PUSH    B
06EB CD8607             CALL    DIVIDE  ;RND(N)=MOD(M,N)+1
06EE C1                 POP     B
06EF D1                 POP     D
06F0 23                 INX     H
06F1 C9                 RET
                ;*
06F2 CDBC06     ABS     CALL    PARN    ;*** ABS(EXPR) ***
06F5 CDA307             CALL    CHKSGN  ;CHECK SIGN
06F8 7C                 MOV     A,H     ;NOTE THAT -32768
06F9 B4                 ORA     H       ;CANNOT CHANGE SIGN
06FA FA6601             JM      QHOW    ;SO SAY: "HOW?"
06FD C9                 RET
```

```
06FE 2AD509     SIZE    LHLD    TXTUNF  ;*** SIZE ***
0701 D5                 PUSH    D       ;GET THE NUMBER OF FREE
0702 EB                 XCHG            ;BYTES BETWEEN 'TXTUNF'
0703 21000F     SIZEA   LXI     H,VARBGN        ;AND 'VARBGN'
0706 CD9C07             CALL    SUBDE
0709 D1                 POP     D
070A C9                 RET
                ;*
                ;**********************************************************
                ;*
                ;*      *** OUT *** INP *** WAIT *** POKE *** PEEK *** & USR
                ;*
                ;*      OUT I,J(,K,L)
                ;*
                ;*      OUTPUTS EXPRESSION 'J' TO PORT 'I', AND MAY BE REPEATED
                ;*      AS IN DATA 'L' TO PORT 'K' AS MANY TIMES AS NEEDED
                ;*      THIS COMMAND MODIFIES ;*        THIS COMMAND MODIFIES
                ;*      THIS COMMAND MODIFY'S A SMALL SECTION OF CODE LOCATED
                ;*      JUST ABOVE ADDRESS 2K
                ;*
                ;*      INP (I)
                ;*
                ;*      THIS FUNCTION RETURNS DATA READ FROM INPUT PORT 'I' AS
                ;*      IT'S VALUE.
                ;*      IT ALSO MODIFIES CODE JUST ABOVE 2K.
                ;*
                ;*      WAIT I,J,K
                ;*
                ;*      THIS COMMAND READS THE STATUS OF PORT 'I', EXCLUSIVE OR'S
                ;*      THE RESULT WITH 'K' IF THERE IS ONE, OR IF NOT WITH 0,
                ;*      AND'S WITH 'J' AND RETURNS WHEN THE RESULT IS NONZERO.
                ;*      ITS MODIFIED CODE IS ALSO ABOVE 2K.
                ;*
                ;*      POKE I,J(,K,L)
                ;*
                ;*      THIS COMMAND WORKS LIKE OUT EXCEPT THAT IT PUTS DATA 'J'
                ;*      INTO MEMORY LOCATION 'I'.
                ;*
                ;*      PEEK (I)
                ;*
                ;*      THIS FUNCTION WORKS LIKE INP EXCEPT IT GETS IT'S VALUE
                ;*      FROM MEMORY LOCATION 'I'.
                ;*
                ;*      USR (I(,J))
                ;*
                ;*      USR CALLS A MACHINE LANGUAGE SUBROUTINE AT LOCATION 'I'
                ;*      IF THE OPTIONAL PARAMETER 'J' IS USED ITS VALUE IS PASSED
                ;*      IN H&L. THE VALUE OF THE FUNCTION SHOULD BE RETURNED IN H&I
                ;*
                ;*************************************************************
                ;*
070B DF         OUTCMD  RST     3
070C 7D                 MOV     A,L
070D 32B109             STA     OUTIO + 1
0710 CF                 RST     1
0711 2C                 DB      ','
0712 2F                 DB      2FH
0713 DF                 RST     3
0714 7D                 MOV     A,L
0715 CDB009             CALL    OUTIO
0718 CF                 RST     1
0719 2C                 DB      ','
071A 03                 DB      03H
071B C30B07             JMP     OUTCMD
071E F7                 RST     6
071F DF         WAITCM  RST     3
0720 7D                 MOV     A,L
0721 32B409             STA     WAITIO + 1
0724 CF                 RST     1
0725 2C                 DB      ','
0726 1B                 DB      1BH
0727 DF                 RST     3
0728 E5                 PUSH    H
0729 CF                 RST     1
072A 2C                 DB      ','
072B 07                 DB      7H
072C DF                 RST     3
072D 7D                 MOV     A,L
072E E1                 POP     H
072F 67                 MOV     H,A
0730 C33207             JMP     $ + 2
0733 2600               MVI     H,0
```

```
0735 C3B309             JMP     WAITIO
0738 CDBC06     INP     CALL    PARN
073B 7D                 MOV     A,L
073C 32BC09             STA     INPIO + 1
073F 2600               MVI     H,0
0741 C3BB09             JMP     INPIO
0744 C3E007             JMP     QWHAT
0747 DF         POKE    RST     3
0748 E5                 PUSH    H
0749 CF                 RST     1
074A 2C                 DB      ','
074B 12                 DB      12H
074C DF                 RST     3
074D 7D                 MOV     A,L
074E E1                 POP     H
074F 77                 MOV     M,A
0750 CF                 RST     1
0751 2C03               DB      ',',03H
0753 C34707             JMP     POKE
0756 F7                 RST 6
0757 CDBC06     PEEK    CALL    PARN
075A 6E                 MOV     L,M
075B 2600               MVI     H,0
075D C9                 RET
075E C3E007             JMP     QWHAT
0761 C5         USR     PUSH    B
0762 CF                 RST     1
0763 281C               DB      '(',28D ;QWHAT
0765 DF                 RST     3       ;EXPR
0766 CF                 RST     1
0767 2907               DB      ')',7   ;PASPARM
0769 D5                 PUSH    D
076A 118007             LXI     D,USRET
076D D5                 PUSH    D
076E E5                 PUSH    H
076F C9                 RET             ;CALL   USR ROUTINE
0770 CF         PASPRM  RST     1
0771 2C0E               DB      ',',14D
0773 E5                 PUSH    H
0774 DF                 RST     3
0775 CF                 RST     1
0776 2909               DB      ')',9
0778 C1                 POP     B
0779 D5                 PUSH    D
077A 118007             LXI     D,USRET
077D D5                 PUSH    D
077E C5                 PUSH    B
077F C9                 RET             ;CALL   USR ROUTINE
0780 D1         USRET   POP     D
0781 C1                 POP     B
0782 C9                 RET
0783 C3E007             JMP     QWHAT
                ;*
                ;**************************************************************
                ;*
                ;* *** DIVIDE *** SUBDE *** CHKSGN *** CHGSGN *** & CKHLDE ***
                ;*
                ;* 'DIVIDE' DIVIDES HL BY DE, RESULT IN BC, REMAINDER IN HL
                ;*
                ;* 'SUBDE' SUBTRACTS DE FROM HL
                ;*
                ;* 'CHKSGN' CHECKS SIGN OF HL.  IFF +, NO CHANGE. IFF -, CHANGE
                ;* SIGN AND FLIP SIGN OF B.
                ;*
                ;* 'CHGSGN' CHNGES SIGN OF HL AND B UNCONDITIONALLY.
                ;*
                ;* 'CKHLE' CHECKS SIGN OF HL AND DE.    IFF DIFFERENT, HL AND DE
                ;* ARE INTERCHANGED.    IFF SAME SIGN, NOT INTERCHANGED.  EITHER
                ;* CASE, HL DE ARE THEN COMPARED TO SET THE FLAGS.
                ;*
0786 E5         DIVIDE PUSH     H       ;*** DIVIDE ***
0787 6C                 MOV     L,H     ;DIVIDE H BY DE
0788 2600               MVI     H,0
078A CD9107             CALL    DV1
078D 41                 MOV     B,C     ;SAVE RESULT IN B
078E 7D                 MOV     A,L     ;(REMAINDER+L)/DE
078F E1                 POP     H
0790 67                 MOV     H,A
0791 0EFF       DV1     MVI     C,377Q  ;RESULT IN C
0793 0C         DV2     INR     C       ;DUMB ROUTINE
0794 CD9C07             CALL    SUBDE   ;DIVIDE BY SUBTRACT
0797 D29307             JNC     DV2     ;AND COUNT
```

```
079A 19                DAD     D
079B C9                RET
               ;*
079C 7D        SUBDE   MOV     A,L     ;*** SUBDE ***
079D 93                SUB     E       ;SUBTRACT DE FROM
079E 6F                MOV     L,A     ;HL
079F 7C                MOV     A,H
07A0 9A                SBB     D
07A1 67                MOV     H,A
07A2 C9                RET
               ;*
07A3 7C        CHKSGN  MOV     A,H     ;*** CHKSGN ***
07A4 B7                ORA     A       ;CHECK SIGN OF HL
07A5 F0                RP              ;IFF -, CHANGE SIGN
               ;*
07A6 7C        CHGSGN  MOV     A,H     ;*** CHGSGN ***
07A7 2F                CMA             ;CHANGE SIGN OF HL
07A8 67                MOV     H,A
07A9 7D                MOV     A,L
07AA 2F                CMA
07AB 6F                MOV     L,A
07AC 23                INX     H
07AD 78                MOV     A,B     ;AND ALSO FLIP B
07AE EE80              XRI     200Q
07B0 47                MOV     B,A
07B1 C9                RET
               ;*
07B2 7C        CKHLDE  MOV     A,H
07B3 AA                XRA     D       ;SAME SIGN?
07B4 F2B807            JP      CK1     ;YES, COMPARE
07B7 EB                XCHG            ;NO, XCH AND COMP
07B8 E7        CK1     RST     4
07B9 C9                RET
               ;*
               ;**************************************************************
               ;*
               ;* *** SETVAL *** FIN *** ENDCHK *** & ERROR (& FRIENDS) ***
               ;*
               ;* "SETVAL" EXPECTS A VARIABLE, FOLLOWED BY AN EQUAL SIGN AND
               ;* THEN AN EXPR. IT EVALUATES THE EXPR. AND SET THE VARIABLE
               ;* TO THAT VALUE.
               ;*
               ;* "FIN" CHECKS THE END OF A COMMAND. IFF IT ENDED WITH ";",
               ;* EXECUTION CONTINUES. IFF IT ENDED WITH A CR, IT FINDS THE
               ;* NEXT LINE AND CONTINUE FROM THERE.
               ;*
               ;* "ENDCHK" CHECKS IFF A COMMAND IS ENDED WITH CR. THIS IS
               ;* REQUIRED IN CERTAIN COMMANDS. (GOTO, RETURN, AND STOP ETC.)
               ;*
               ;* "ERROR" PRINTS THE STRING POINTED BY DE (AND ENDS WITH CR).
               ;* IT THEN PRINTS THE LINE POINTED BY 'CURRNT' WITH A "?"
               ;* INSERTED AT WHERE THE OLD TEXT POINTER (SHOULD BE ON TOP
               ;* O THE STACK) POINTS TO. EXECUTION OF TB IS STOPPED
               ;* AND TBI IS RESTARTED. HOWEVER, IFF 'CURRNT' -> ZERO
               ;* (INDICATING A DIRECT COMMAND), THE DIRECT COMMAND IS NOT
               ;* PRINTED. AND IFF 'CURRNT' -> NEGATIVE # (INDICATING 'INPUT'
               ;* COMMAND, THE INPUT LINE IS NOT PRINTED AND EXECUTION IS
               ;* NOT TERMINATED BUT CONTINUED AT 'INPERR'.
               ;*
               ;* RELATED TO 'ERROR' ARE THE FOLLOWING:
               ;* 'QWHAT' SAVES TEXT POINTER IN STACK AND GET MESSAGE "WHAT?"
               ;* 'AWHAT' JUST GET MESSAGE "WHAT?" AND JUMP TO 'ERROR'.
               ;* 'QSORRY' AND 'ASORRY' DO SAME KIND OF THING.
               ;* 'QHOW' AND 'AHOW' IN THE ZERO PAGE SECTION ALSO DO THIS
               ;*
07BA FF        SETVAL  RST     7       ;*** SETVAL ***
07BB DAE007            JC      QWHAT   ;"WHAT?" NO VARIABLE
07BE E5                PUSH    H       ;SAVE ADDRESS OF VAR.
07BF CF                RST     1       ;PASS "=" SIGN
07C0 3D                DB      '='
07C1 08                DB      10Q
07C2 DF                RST     3       ;EVALUATE EXPR.
07C3 44                MOV     B,H     ;VALUE IN BC NOW
07C4 4D                MOV     C,L
07C5 E1                POP     H       ;GET ADDRESS
07C6 71                MOV     M,C     ;SAVE VALUE
07C7 23                INX     H
07C8 70                MOV     M,B
07C9 C9                RET
07CA C3E007    SV1     JMP     QWHAT   ;NO "=" SIGN
               ;*
```

```
07CD CF          FIN     RST     1        ;*** FIN ***
07CE 3B                  DB      73Q
07CF 04                  DB      4Q
07D0 F1                  POP     PSW      ;";", PURGE RET ADDR.
07D1 C32B03              JMP     RUNSML   ;CONTINUE SAME LINE
07D4 CF          FI1     RST     1        ;NOT ";", IS IT CR?
07D5 0D                  DB      0DH
07D6 04                  DB      4Q
07D7 F1                  POP     PSW      ;YES, PURGE RET ADDR.
07D8 C31B03              JMP     RUNNXL   ;RUN NEXT LINE
07DB C9          FI2     RET              ;ELSE RETURN TO CALLER
                 ;*
07DC EF          ENDCHK  RST     5        ;*** ENDCHK ***
07DD FE0D                CPI     0DH      ;END WITH CR?
07DF C8                  RZ               ;OK, ELSE SAY: "WHAT?"
                 ;*
07E0 D5          QWHAT   PUSH    D        ;*** QWHAT ***
07E1 117501      AWHAT   LXI     D,WHAT   ;*** AWHAT ***
07E4 97          ERROR   SUB     A        ;*** ERROR ***
07E5 CD7F08              CALL    PRTSTG   ;PRINT 'WHAT?', 'HOW?'
07E8 D1                  POP     D        ;OR 'SORRY'
07E9 1A                  LDAX    D        ;SAVE THE CHARACTER
07EA F5                  PUSH    PSW      ;AT WHERE OLD DE ->
07EB 97                  SUB     A        ;AND PUT A 0 THERE
07EC 12                  STAX    D
07ED 2AC109              LHLD    CURRNT   ;GET CURRENT LINE #
07F0 E5                  PUSH    H
07F1 7E                  MOV     A,M      ;CHECK THE VALUE
07F2 23                  INX     H
07F3 B6                  ORA     M
07F4 D1                  POP     D
07F5 CA8101              JZ      RSTART   ;IFF ZERO, JUST RERSTART
07F8 7E                  MOV     A,M      ;IFF NEGATIVE,
07F9 B7                  ORA     A
07FA FA6805              JM      INPERR   ;REDO INPUT
07FD CDED08              CALL    PRTLN    ;ELSE PRINT THE LINE
0800 1B                  DCX     D        ;UPTO WHERE THE 0 IS
0801 F1                  POP     PSW      ;RESTORE THE CHARACTER
0802 12                  STAX    D
0803 3E3F                MVI     A,77Q    ;PRINTT A "?"
0805 D7                  RST     2
0806 97                  SUB     A        ;AND THE REST OF THE
0807 CD7F08              CALL    PRTSTG   ;LINE
080A C38101              JMP     RSTART
080D D5          QSORRY  PUSH    D        ;*** QSORRY ***
080E 117B01      ASORRY  LXI     D,SORRY  ;*** ASORRY ***
0811 C3E407              JMP     ERROR
                 ;*
                 ;**************************************************************
                 ;*
                 ;* *** GETLN *** FNDLN (& FRIENDS) ***
                 ;*
                 ;* 'GETLN' READS A INPUT LINE INTO 'BUFFER'. IT FIRST PROMPT
                 ;* THE CHARACTER IN A (GIVEN BY THE CALLER), THEN IT FILLS THE
                 ;* THE BUFFER AND ECHOS. IT IGNORES LF'S AND NULLS, BUT STILL
                 ;* ECHOS THEM BACK. RUB-OUT IS USED TO CAUSE IT TO DELETE
                 ;* THE LAST CHARATER (IFF THERE IS ONE), AND ALT-MOD IS USED TO
                 ;* CAUSE IT TO DELETE THE WHOLE LINE AND START IT ALL OVER.
                 ;* 0DHSIGNALS THE END OF A LINE, AND CAUE 'GETLN' TO RETURN.
                 ;*
                 ;* 'FNDLN' FINDS A LINE WITH A GIVEN LINE # (IN HL) IN THE
                 ;* TEXT SAVE AREA. DE IS USED AS THE TEXT POINTER. IFF THE
                 ;* LINE IS FOUND, DE WILL POINT TO THE BEGINNING OF THAT LINE
                 ;* (I.E., THE LOW BYTE OF THE LINE #), AND FLAGS ARE NC & Z.
                 ;* IFF THAT LINE IS NOT THERE AND A LINE WITH A HIGHER LINE #
                 ;* IS FOUND, DE POINTS TO THERE AND FLAGS ARE NC & NZ.  IFF
                 ;* WE REACHED THE END OF TEXT SAVE ARE AND CANNOT FIND THE
                 ;* LINE, FLAGS ARE C & NZ.
                 ;* 'FNDLN' WILL INITIALIZE DE TO THE BEGINNING OF THE TEXT SAVE
                 ;* AREA TO START THE SEARCH. SOME OTHER ENTRIES OF THIS
                 ;* ROUTINE WILL NOT INITIALIZE DE AND DO THE SEARCH.
                 ;* 'FNDLNP' WILL START WITH DE AND SEARCH FOR THE LINE #.
                 ;* 'FNDNXT' WILL BUMP DE BY 2, FIND A 0DHAND THEN START SEARCH.
                 ;* 'FNDSKP' USE DE TO FIND A CR, AND THEN STRART SEARCH.
                 ;*
0814 D7          GETLN   RST     2        ;*** GETLN ***
0815 11370F              LXI     D,BUFFER  ;PROMPT AND INIT
0818 CD8509      GL1     CALL    CHKIO    ;CHECK KEYBOARD
081B CA1808              JZ      GL1      ;NO INPUT, WAIT
081E FE7F                CPI     177Q     ;DELETE LST CHARACTER?
0820 CA4208              JZ      GL3      ;YES
0823 FE0A                CPI     12Q      ;IGNORE LF
```

```
0825 CA1808             JZ      GL1
0828 B7                 ORA     A       ;IGNORE NULL
0829 CA1808             JZ      GL1
082C FE5C               CPI     134Q    ;DELETE THE WHOLE LINE?
082E CA4F08             JZ      GL4     ;YES
0831 12                 STAX    D       ;ELSE, SAVE INPUT
0832 13                 INX     D       ;AND BUMP POINTER
0833 FE0D               CPI     15Q     ;WAS IT CR?
0835 C23C08             JNZ     GL2     ;NO
0838 3E0A               MVI     A,12Q   ;YES, GET LINE FEED
083A D7                 RST     2       ;CALL   OUTC AND LINE FEED
083B C9                 RET             ;WE'VE GOT A LINE
083C 7B        GL2      MOV     A,E     ;MORE FREE ROOM?
083D FE87               CPI     BUFEND AND OFFH
083F C21808             JNZ     GL1     ;YES, GET NEXT INPUT
0842 7B        GL3      MOV     A,E     ;DELETE LAST CHARACTER
0843 FE37               CPI     BUFFER AND OFFH ;BUT DO WE HAVE ANY?
0845 CA4F08             JZ      GL4     ;NO, REDO WHOLE LINE
0848 1B                 DCX     D       ;YES, BACKUP POINTER
0849 3E5F               MVI     A,'_'   ;AND ECHO A BACK-SPACE
084B D7                 RST     2
084C C31808             JMP     GL1     ;GO GET NEXT INPUT
084F CD0E00    GL4      CALL    CRLF    ;REDO ENTIRE LINE
0852 3E5E               MVI     A,136Q  ;CR, LF AND UP-ARROW
0854 C31408             JMP     GETLN
               ;*
0857 7C        FNDLN    MOV     A,H     ;*** FNDLN ***
0858 B7                 ORA     A       ;CHECK SIGN OF HL
0859 FA6601             JM      QHOW    ;IT CANNT BE -
085C 11D709             LXI     D,TXTBGN  ;INIT. TEXT POINTER
               ;*
085F =         FNDLNP   EQU     $       ;*** FNDLNP ***
085F E5        FL1      PUSH    H       ;SAVE LINE #
0860 2AD509             LHLD    TXTUNF  ;CHECK IFF WE PASSED END
0863 2B                 DCX     H
0864 E7                 RST     4
0865 E1                 POP     H       ;GET LINE # BACK
0866 D8                 RC              ;C,NZ PASSED END
0867 1A                 LDAX    D       ;WE DID NOT, GET BYTE 1
0868 95                 SUB     L       ;IS THIS THE LINE?
0869 47                 MOV     B,A     ;COMPARE LOW ORDER
086A 13                 INX     D
086B 1A                 LDAX    D       ;GET BYTE 2
086C 9C                 SBB     H       ;COMPARE HIGH ORDER
086D DA7408             JC      FL2     ;NO, NOT THERE YET
0870 1B                 DCX     D       ;ELSE WE EITHER FOUND
0871 B0                 ORA     B       ;IT, OR IT IS NOT THERE
0872 C9                 RET             ;NC,Z:FOUND; NC,NZ:NO
               ;*
0873 =         FNDNXT   EQU     $       ;*** FNDNXT ***
0873 13                 INX     D       ;FIND NEXT LINE
0874 13        FL2      INX     D       ;JUST PASSED BYTE 1 & 2
               ;*
0875 1A        FNDSKP   LDAX    D       ;*** FNDSKP ***
0876 FE0D               CPI     0DH     ;TRY TO FIND 0DH
0878 C27408             JNZ     FL2     ;KEEP LOOKING
087B 13                 INX     D       ;FOUND CR, SKIP OVER
087C C35F08             JMP     FL1     ;CHECK IFF END OF TEXT
               ;*
               ;*************************************************************
               ;*
               ;* *** PRTSTG *** QTSTG *** PRTNUM *** & PRTLN ***
               ;*
               ;* 'PRTSTG' PRINTS A STRING POINTED BY DE. IT STOPS PRINTING
               ;* AND RETURNS TO CALLER WHEN EITHER A 0DHIS PRINTED OR WHEN
               ;* THE NEXT BYTE IS THE SAME AS WHAT WAS IN A (GIVEN BY THE
               ;* CALLER). OLD A IS STORED IN B, OLD B IS LOST.
               ;*
               ;* 'QTSTG' LOOKS FOR A BACK-ARROW, SINGLE QUOTE, OR DOUBLE
               ;* QUOTE. IFF NONE OF THESE, RETURN TO CALLER. IFF BACK-ARROW,
               ;* OUTPUT A 0DHWITHOUT A LF.  IFF SINGLE OR DOUBLE QUOTE, PRINT
               ;* THE STRING IN THE QUOTE AND DEMANDS A MATCHING UNQUOTE.
               ;* AFTER THE PRINTING THE NEXT 3 BYTES OF THE CALLER IS SKIPPED
               ;* OVER (USUALLY A JUMP INSTRUCTION).
               ;*
               ;* 'PRTNUM' PRINTS THE NUMBER IN HL. LEADING BLANKS ARE ADDED
               ;* IFF NEEDED TO PAD THE NUMBER OF SPACES TO THE NUMBER IN C.
               ;* HOWEVER, IFF THE NUMBER OF DIGITS IS LARGER THAN THE # IN
               ;* C, ALL DIGITS ARE PRINTED ANYWAY. NEGATIVE SIGN IS ALSO
               ;* PRINTED AND COUNTED IN, POSITIVE SIGN IS NOT.
               ;*
               ;* 'PRTLN' PRINSRA SAVED TEXT LINE WITH LINE # AND ALL.
```

```
                  ;*
087F 47           PRTSTG  MOV     B,A      ;*** PRTSTG ***
0880 1A           PS1     LDAX    D        ;GET A CHARACTERR
0881 13                   INX     D        ;BUMP POINTER
0882 B8                   CMP     B        ;SAME AS OLD A?
0883 C8                   RZ               ;YES, RETURN
0884 D7                   RST     2        ;ELSE PRINT IT
0885 FE0D                 CPI     0DH      ;WAS IT A CR?
0887 C28008               JNZ     PS1      ;NO, NEXT
088A C9                   RET              ;YES, RETURN
                  ;*
088B CF           QTSTG   RST     1        ;*** QTSTG ***
088C 22                   DB      '"'
088D 0F                   DB      17Q
088E 3E22                 MVI     A,42Q    ;IT IS A "
0890 CD7F08       QT1     CALL    PRTSTG   ;PRINT UNTIL ANOTHER
0893 FE0D                 CPI     0DH      ;WAS LAST ONE A CR?
0895 E1                   POP     H        ;RETURN ADDRESS
0896 CA1B03               JZ      RUNNXL   ;WAS CR, RUN NEXT LINE
0899 23           QT2     INX     H        ;SKIP 3 BYTES ON RETURN
089A 23                   INX     H
089B 23                   INX     H
089C E9                   PCHL             ;RETURN
089D CF           QT3     RST     1        ;IS IT A ' ?
089E 27                   DB      47Q
089F 05                   DB      5Q
08A0 3E27                 MVI     A,47Q    ;YES, DO SAME
08A2 C39008               JMP     QT1      ;AS IN "
08A5 CF           QT4     RST     1        ;IS IT BACK-ARROW?
08A6 5F                   DB      137Q
08A7 08                   DB      10Q
08A8 3E8D                 MVI     A,215Q   ;YES, 0DHWITHOUT LF!!
08AA D7                   RST     2        ;DO IT TWICE TO GIVE
08AB D7                   RST     2        ;TTY ENOUGH TIME
08AC E1                   POP     H        ;RETURN ADDRESS
08AD C39908               JMP     QT2
08B0 C9           QT5     RET              ;NONE OF ABOVE
                  ;*
08B1 D5           PRTNUM  PUSH    D        ;*** PRTNUM ***
08B2 110A00               LXI     D,12Q    ;DECIMAL
08B5 D5                   PUSH    D        ;SAVE AS A FLAG
08B6 42                   MOV     B,D      ;B=SIGN
08B7 0D                   DCR     C        ;C=SPACES
08B8 CDA307               CALL    CHKSGN   ;CHECK SIGN
08BB F2C108               JP      PN1      ;NO SIGN
08BE 062D                 MVI     B,55Q    ;B=SIGN
08C0 0D                   DCR     C        ;'-' TAKES SPACE
08C1 C5           PN1     PUSH    B        ;SAVE SIGN & SPACE
08C2 CD8607       PN2     CALL    DIVIDE   ;DEVIDE HL BY 10
08C5 78                   MOV     A,B      ;RESULT 0?
08C6 B1                   ORA     C
08C7 CAD208               JZ      PN3      ;YES, WE GOT ALL
08CA E3                   XTHL             ;NO, SAVE REMAINDER
08CB 2D                   DCR     L        ;AND COUNT SPACE
08CC E5                   PUSH    H        ;HL IS OLD BC
08CD 60                   MOV     H,B      ;MOVE RESULT TO BC
08CE 69                   MOV     L,C
08CF C3C208               JMP     PN2      ;AND DIVIDE BY 10
08D2 C1           PN3     POP     B        ;WE GOT ALL DIGITS IN
08D3 0D           PN4     DCR     C        ;THE STACK
08D4 79                   MOV     A,C      ;LOOK AT SPACE COUNT
08D5 B7                   ORA     A
08D6 FADF08               JM      PN5      ;NO LEADING BLANKS
08D9 3E20                 MVI     A,40Q    ;LEADING BLANKS
08DB D7                   RST     2
08DC C3D308               JMP     PN4      ;MORE?
08DF 78           PN5     MOV     A,B      ;PRINT SIGN
08E0 D7                   RST     2        ;MAYBE - OR NULL
08E1 5D                   MOV     E,L      ;LAST REMAINDER IN E
08E2 7B           PN6     MOV     A,E      ;CHECK DIGIT IN E
08E3 FE0A                 CPI     12Q      ;10 IS FLAG FOR NO MORE
08E5 D1                   POP     D
08E6 C8                   RZ               ;IFF SO, RETURN
08E7 C630                 ADI     60Q      ;ELSE CONVERT TO ASCII
08E9 D7                   RST     2        ;AND PRINT THE DIGIT
08EA C3E208               JMP     PN6      ;GO BACK FOR MORE
                  ;*
08ED 1A           PRTLN   LDAX    D        ;*** PRTLN ***
08EE 6F                   MOV     L,A      ;LOW ORDER LINE #
08EF 13                   INX     D
08F0 1A                   LDAX    D        ;HIGH ORDER
08F1 67                   MOV     H,A
```

```
08F2 13                     INX     D
08F3 0E04                   MVI     C,4Q     ;PRINT 4 DIGIT LINE #
08F5 CDB108                 CALL    PRTNUM
08F8 3E20                   MVI     A,40Q    ;FOLLOWED BY A BLANK
08FA D7                     RST     2
08FB 97                     SUB     A        ;AND THEN THE TEXT
08FC CD7F08                 CALL    PRTSTG
08FF C9                     RET
                    ;*
                    ;**************************************************************
                    ;*
                    ;* *** MVUP *** MVDOWN *** POPA *** & PUSHA ***
                    ;*
                    ;* 'MVUP' MOVES A BLOCK UP FROM HERE DE-> TO WHERE BC-> UNTIL
                    ;* DE = HL
                    ;*
                    ;* 'MVDOWN' MOVES A BLOCK DOWN FROM WHERE DE-> TO WHERE HL->
                    ;* UNTIL DE = BC
                    ;*
                    ;* 'POPA' RESTORES THE 'FOR' LOOP VARIABLE SAVE AREA FROM THE
                    ;* STACK
                    ;*
                    ;* 'PUSHA' STACKS THE 'FOR' LOOP VARIABLE SAVE AREA INTO THE
                    ;* STACK
                    ;*
0900 E7             MVUP    RST     4        ;*** MVUP ***
0901 C8                     RZ               ;DE = HL, RETURN
0902 1A                     LDAX    D        ;GET ONE BYTE
0903 02                     STAX    B        ;MOVE IT
0904 13                     INX     D        ;INCREASE BOTH POINTERS
0905 03                     INX     B
0906 C30009                 JMP     MVUP     ;UNTIL DONE
                    ;*
0909 78             MVDOWN MOV      A,B      ;*** MVDOWN ***
090A 92                     SUB     D        ;TEST IFF DE = BC
090B C21109                 JNZ     MD1      ;NO, GO MOVE
090E 79                     MOV     A,C      ;MAYBE, OTHER BYTE?
090F 93                     SUB     E
0910 C8                     RZ               ;YES, RETURN
0911 1B             MD1     DCX     D        ;ELSE MOVE A BYTE
0912 2B                     DCX     H        ;BUT FIRST DECREASE
0913 1A                     LDAX    D        ;BOTH POINTERS AND
0914 77                     MOV     M,A      ;THEN DO IT
0915 C30909                 JMP     MVDOWN   ;LOOP BACK
                    ;*
0918 C1             POPA    POP     B        ;BC = RETURN ADDR.
0919 E1                     POP     H        ;RESTORE LOPVAR, BUT
091A 22C909                 SHLD    LOPVAR   ;=0 MEANS NO MORE
091D 7C                     MOV     A,H
091E B5                     ORA     L
091F CA3209                 JZ      PP1      ;YEP, GO RETURN
0922 E1                     POP     H        ;NOP, RESTORE OTHERS
0923 22CB09                 SHLD    LOPINC
0926 E1                     POP     H
0927 22CD09                 SHLD    LOPLMT
092A E1                     POP     H
092B 22CF09                 SHLD    LOPLN
092E E1                     POP     H
092F 22D109                 SHLD    LOPPT
0932 C5             PP1     PUSH    B        ;BC = RETURN ADDR.
0933 C9                     RET
                    ;*
0934 21AF0F         PUSHA   LXI     H,STKLMT  ;*** PUSHA ***
0937 CDA607                 CALL    CHGSGN
093A C1                     POP     B        ;BC=RETURN ADDRESS
093B 39                     DAD     SP       ;IS STACK NEAR THE TOP?
093C D20D08                 JNC     QSORRY   ;YES, SORRY FOR THAT.
093F 2AC909                 LHLD    LOPVAR   ;ELSE SAVE LOOP VAR.S
0942 7C                     MOV     A,H      ;BUT IFF LOPVAR IS 0
0943 B5                     ORA     L        ;THAT WILL BE ALL
0944 CA5A09                 JZ      PU1
0947 2AD109                 LHLD    LOPPT    ;ELSE, MORE TO SAVE
094A E5                     PUSH    H
094B 2ACF09                 LHLD    LOPLN
094E E5                     PUSH    H
094F 2ACD09                 LHLD    LOPLMT
0952 E5                     PUSH    H
0953 2ACB09                 LHLD    LOPINC
0956 E5                     PUSH    H
0957 2AC909                 LHLD    LOPVAR
095A E5             PU1     PUSH    H
095B C5                     PUSH    B        ;BC = RETURN ADDR.
```

```
095C C9                RET
               ;*
               ;**************************************************************
               ;*
               ;* *** OUTC *** & CHKIO ***
               *!
               ;* THESE ARE THE ONLY I/O ROUTINES IN TBI.
               ;* 'OUTC' IS CONTROLLED BY A SOFTWARE SWITCH 'OCSW'. IFF OCSW=0
               ;* 'OUTC' WILL JUST RETURN TO THE CALLER. IFF OCSW IS NOT 0,
               ;* IT WILL OUTPUT THE BYTE IN A. IFF THAT IS A CR, A LF IS ALSO
               ;* SEND OUT.    ONLY THE FLAGS MAY BE CHANGED AT RETURN, ALL REG.
               ;* ARE RESTORED.
               ;*
               ;* 'CHKIO' CHECKS THE INPUT. IFF NO INPUT, IT WILL RETURN TO
               ;* THE CALLER WITH THE Z FLAG SET. IFF THERE IS INPUT, Z FLAG
               ;* IS CLEARED AND THE INPUT BYTE IS IN A. HOWERER, IFF THE
               ;* INPUT IS A CONTROL-O, THE 'OCSW' SWITCH IS COMPLIMENTED, AND
               ;* Z FLAG IS RETURNED.  IFF A CONTROL-C IS READ, 'CHKIO' WILL
               ;* RESTART TBI AND DO NOT RETURN TO THE CALLER.
               ;*
               ;*       OUTC   PUSH    AF               THIS IS AT LOC. 10
               ;*              LD      A,OCSW  CHECK SOFTWARE SWITCH
               ;*              IOR     A
095D C26209    OC2     JNZ     OC3     ;IT IS ON
0960 F1                POP     PSW     ;IT IS OFF
0961 C9                RET             ;RESTORE AF AND RETURN
0962 F1        OC3     POP     A       ;GET OLD A BACK
0963 C5                PUSH    B       ;SAVE B ON STACK
0964 D5                PUSH    D       ;AND D
0965 E5                PUSH    H       ;AND H TOO
0966 32BF09            STA     OUTCAR  ;SAVE CHARACTER
0969 5F                MOV     E,A     ;PUT CHAR. IN E FOR CPM
096A 0E02              MVI     C,2     ;GET CONOUT COMMAND
096C CD0500            CALL    CPM     ;CALL   CPM AND DO IT
096F 3ABF09            LDA     OUTCAR  ;GET CHAR. BACK
0972 FE0D              CPI     0DH     ;WAS IT A 'CR'?
0974 C27E09            JNZ     DONE    ;NO, DONE
0977 1E0A              MVI     E,0AH   ;GET LINEFEED
0979 0E02              MVI     C,2     ;AND CONOUT AGAIN
097B CD0500            CALL    CPM     ;CALL   CPM
097E 3ABF09    DONE    LDA     OUTCAR  ;GET CHARACTER BACK
0981 E1        IDONE   POP     H       ;GET H BACK
0982 D1                POP     D       ;AND D
0983 C1                POP     B       ;AND B TOO
0984 C9                RET             ;DONE AT LAST
0985 C5        CHKIO   PUSH    B       ;SAVE B ON STACK
0986 D5                PUSH    D       ;AND D
0987 E5                PUSH    H       ;THEN H
0988 0E0B              MVI     C,11    ;GET CONSTAT WORD
098A CD0500            CALL    CPM     ;CALL   THE BDOS
098D B7                ORA     A       ;SET FLAGS
098E C29409            JNZ     CI1     ;IF READY GET CHARACTER
0991 C38109            JMP     IDONE   ;RESTORE AND RETURN
0994 0E01      CI1     MVI     C,1     ;GET CONIN WORD
0996 CD0500            CALL    CPM     ;CALL   THE BDOS
0999 FE0F              CPI     0FH     ;IS IT CONTROL-O?
099B C2A809            JNZ     CI2     ;NO, MORE CHECKING
099E 3AC009            LDA     OCSW    ;CONTROL-O      FLIP OCSW
09A1 2F                CMA             ;ON TO OFF, OFF TO ON
09A2 32C009            STA     OCSW    ;AND PUT IT BACK
09A5 C38509            JMP     CHKIO   ;AND GET ANOTHER CHARACTER
09A8 FE03      CI2     CPI     3       ;IS IT CONTROL-C?
09AA C28109            JNZ     IDONE   ;RETURN AND RESTORE IF NOT
09AD C38101            JMP     RSTART  ;YES, RESTART TBI
09B0 =         LSTROM  EQU     $       ;ALL ABOVE CAN BE ROM
09B0 D3FF      OUTIO   OUT     0FFH
09B2 C9                RET
09B3 DBFF      WAITIO  IN      0FFH
09B5 AC                XRA     H
09B6 A5                ANA     L
09B7 CAB309            JZ      WAITIO
09BA F7                RST     6
09BB DBFF      INPIO   IN      0FFH
09BD 6F                MOV     L,A
09BE C9                RET
09BF 00        OUTCAR  DB      0       ;OUTPUT CHAR. STORAGE
09C0 FF        OCSW    DB      0FFH    ;SWITCH FOR OUTPUT
09C1 0000      CURRNT  DW      0       ;POINTS TO CURRENT LINE
09C3 0000      STKGOS  DW      0       ;SAVES SP IN 'GOSUB'
09C5 0000      VARNXT  DW      0       ;TEMPORARY STORAGE
09C7 0000      STKINP  DW      0       ;SAVES SP IN 'INPUT'
09C9 0000      LOPVAR  DW      0       ;'FOR' LOOP SAVE AREA
```

```
09CB 0000         LOPINC  DW      0         ;INCREMENT
09CD 0000         LOPLMT  DW      0         ;LIMIT
09CF 0000         LOPLN   DW      0         ;LINE NUMBER
09D1 0000         LOPPT   DW      0         ;TEXT POINTER
09D3 0001         RANPNT  DW      START     ;RANDOM NUMBER POINTER
09D5 D709         TXTUNF  DW      TXTBGN    ;->UNFILLED TEXT AREA
09D7              TXTBGN  DS      1         ;TEXT SAVE AREA BEGINS
09D8 7F7F7F5348MSG1       DB      7FH,7FH,7FH,'SHERRY BROTHERS TINY BASIC VER. 3.1',
09FF 3EFF         INIT    MVI     A,0FFH
0A01 32C009               STA     OCSW      ;TURN ON OUTPUT SWITCH
0A04 3E0C                 MVI     A,0CH     ;GET FORM FEED
0A06 D7                   RST     2         ;SEND TO CRT
0A07 97           PATLOP  SUB     A         ;CLEAR ACCUMULATOR
0A08 11D809               LXI     D,MSG1    ;GET INIT MESSAGE
0A0B CD7F08               CALL    PRTSTG    ;SEND IT
0A0E 3A0700       LSTRAM  LDA     7         ;GET FBASE FOR TOP
0A11 328301               STA     RSTART+2
0A14 3D                   DCR     A         ;DECREMENT FOR OTHER POINTERS
0A15 321901               STA     SS1A+2    ;AND FIX THEM TOO
0A18 322601               STA     TV1A+2
0A1B 32A501               STA     ST3A+2
0A1E 32E501               STA     ST4A+2
0A21 32AB05               STA     IP3A+2
0A24 320507               STA     SIZEA+2
0A27 321708               STA     GETLN+3
0A2A 323609               STA     PUSHA+2
0A2D 218401               LXI     H,ST1     ;GET NEW START JUMP
0A30 220101               SHLD    START+1   ;AND FIX IT
0A33 C38401               JMP     ST1
                  ;       RESTART TABLE
0A50                      ORG     0A50H
                  RSTBL:
0A50 E3                   XTHL              ;*** TSTC OR RST 1 ***
0A51 EF                   RST     5         ;IGNORE BLANKS AND
0A52 BE                   CMP     M         ;TEST CHARACTER
0A53 C32F01               JMP     TC1       ;REST OF THIS IS AT TC1
                  ;*
000E =            CRLF:   EQU     0EH       ;EXECUTE TIME LOCATION OF THIS INSTRUCTION
0A56 3E0D                 MVI     A,0DH     ;*** CRLF ***
                  ;*
0A58 F5                   PUSH    PSW       ;*** OUTC OR RST 2 ***
0A59 3AC009               LDA     OCSW      ;PRINT CHARACTER ONLY
0A5C B7                   ORA     A         ;IFF OCSW SWITCH IS ON
0A5D C35D09               JMP     OC2       ;REST OF THIS IS AT OC2
                  ;*
0A60 CD1606               CALL    EXPR2     ;*** EXPR OR RST 3 ***
0A63 E5                   PUSH    H         ;EVALUATE AN EXPRESION
0A64 C3D205               JMP     EXPR1     ;REST OF IT IS AT EXPR1
0A67 57                   DB      'W'
                  ;*
0A68 7C                   MOV     A,H       ;*** COMP OR RST 4 ***
0A69 BA                   CMP     D         ;COMPARE HL WITH DE
0A6A C0                   RNZ               ;RETURN CORRECT C AND
0A6B 7D                   MOV     A,L       ;Z FLAGS
0A6C BB                   CMP     E         ;BUT OLD A IS LOST
0A6D C9                   RET
0A6E 414E                 DB      'AN'
                  ;*
0028 =            SS1:    EQU     28H       ;EXECUTE TIME LOCATION OF THIS INSTRUCTION
0A70 1A                   LDAX    D         ;*** IGNBLK/RST 5 ***
0A71 FE20                 CPI     40Q       ;IGNORE BLANKS
0A73 C0                   RNZ               ;IN TEXT (WHERE DE->)
0A74 13                   INX     D         ;AND RETURN THE FIRST
0A75 C32800               JMP     SS1       ;NON-BLANK CHAR. IN A
                  ;*
0A78 F1                   POP     PSW       ;*** FINISH/RST 6 ***
0A79 CDCD07               CALL    FIN       ;CHECK END OF COMMAND
0A7C C3E007               JMP     QWHAT     ;PRINT "WHAT?" IFF WRONG
0A7F 47                   DB      'G'
                  ;*
0A80 EF                   RST     5          ;*** TSTV OR RST 7 ***
0A81 D640                 SUI     100Q      ;TEST VARIABLES
0A83 D8                   RC                ;C:NOT A VARIABLE
0A84 C30301               JMP     TSTV1     ;JUMP AROUND RESERVED AREA
                  ; ROUTINE TO COPY RESTART TABLE INTO LOW MEMORY
0008 =            RST1:   EQU     8         ;LOCATION FIRST REATART ROUTINE

0040 =            EOT:    EQU     40H       ;LAST LOC TO BE FILLED

0AA0                      ORG     0AA0H
0AA0 210800       NINIT:  LXI     H,RST1    ;POINT TO BEGINNING OF MODEL TABLE
0AA3 11500A               LXI     D,RSTBL
```

```
0AA6 1A         NXT:    LDAX    D
0AA7 77                 MOV     M,A
0AA8 23                 INX     H
0AA9 13                 INX     D
0AAA 3E40               MVI     A,EOT
0AAC BD                 CMP     L
0AAD C2A60A             JNZ     NXT
0AB0 21FF09             LXI     H,INIT
0AB3 220101             SHLD    START+1
0AB6 C30001             JMP     START
0F00                    ORG     0F00H
0F00 =          TXTEND  EQU     $       ;TEXT SAVE AREA ENDS
0F00            VARBGN  DS      2*27    ;VARIABLE @(0)
0F36                    DS      1       ;EXTRA BYTE FOR BUFFER
0F37            BUFFER  DS      80      ;INPUT BUFFER
0F87 =          BUFEND  EQU     $       ;BUFFER ENDS
0F87                    DS      40      ;EXTRA BYTES FOR STACK
0FAF =          STKLMT  EQU     $       ;TOP LIMIT FOR STACK
2000                    ORG     2000H
2000 =          STACK   EQU     $       ;STACK STARTS HERE
2000                    END

06F2 ABS        0167 AHOW       080E ASORRY     07E1 AWHAT      0F87 BUFEND
0F37 BUFFER     07A6 CHGSGN     0985 CHKIO      07A3 CHKSGN     0994 CI1
09A8 CI2        07B8 CK1        07B2 CKHLDE     0010 CLOSE      0005 CPM
000E CRLF       09C1 CURRNT     05C2 DEFLT      0013 DELETE     02D5 DIRECT
0786 DIVIDE     0343 DLOAD      097E DONE       038A DSAVE      0791 DV1
0793 DV2        07DC ENDCHK     0040 EOT        07E4 ERROR      02D8 EX0
02DA EX1        02ED EX2        02F7 EX3        02F9 EX4        02FE EX5
02D8 EXEC       05D2 EXPR1      0616 EXPR2      064A EXPR3      06A7 EXPR4
03FC EXRC       005C FCB        03E5 FCBSET     07D4 FI1        07DB FI2
07CD FIN        085F FL1        0874 FL2        03EA FNCLR      0857 FNDLN
085F FNDLNP     0873 FNDNXT     0408 FN         0875 FNDSKP     04A9 FOR
04B9 FR1        04C3 FR2        04C7 FR3        04CA FR4        04CD FR5
04E2 FR7        0503 FR8        0814 GETLN      0818 GL1        083C GL2
0842 GL3        084F GL4        0470 GOSUB      0334 GOTO       016D HOW
0981 IDONE      0559 IFF        09FF INIT       0738 INP        0568 INPERR
09BB INPIO      0572 INPUT      0572 IP1        0580 IP2        0590 IP3
05A9 IP3A       05BA IP4        05C1 IP5        05C8 LET        0420 LIST
035E LOAD       09CB LOPINC     09CD LOPLMT     09CF LOPLN      09D1 LOPPT
09C9 LOPVAR     0429 LS1        0A0E LSTRAM     09B0 LSTROM     05D1 LT1
0016 MAKE       0911 MD1        09D8 MSG1       0909 MVDOWN     0900 MVUP
0306 NEW        0508 NEXT       0AA0 NINIT      050F NX0        053F NX1
0551 NX2        0527 NX3        0AA6 NXT        095D OC2        0962 OC3
09C0 OCSW       0172 OK         000F OPEN       09BF OUTCAR     070B OUTCMD
09B0 OUTIO      06BC PARN       0770 PASPRM     0A07 PATLOP     0757 PEEK
08C1 PN1        08C2 PN2        08D2 PN3        08D3 PN4        08DF PN5
08E2 PN6        0747 POKE       0918 POPA       0932 PP1        044C PR0
0454 PR1        0443 PR2        045A PR3        0463 PR6        0467 PR8
0438 PRINT      08ED PRTLN      08B1 PRTNUM     087F PRTSTG     0880 PS1
095A PU1        0934 PUSHA      0166 QHOW       080D QSORRY     0890 QT1
0899 QT2        089D QT3        08A5 QT4        08B0 QT5        088B QTSTG
07E0 QWHAT      06E2 RA1        09D3 RANPNT     0381 RDMORE     0014 READD
0555 REM        0490 RETURN     06C7 RND        0008 RST1       0181 RSTART
0A50 RSTBL      0315 RUN        031B RUNNXL     032B RUNSML     0324 RUNTSL
03D9 SAVDON     03AD SAVE       001A SETDMA     07BA SETVAL     06FE SIZE
0703 SIZEA      017B SORRY      0117 SS1A       0028 SS1        0184 ST1
0194 ST2        019D ST3        01A3 ST3A       01D2 ST4        01E3 ST4A
2000 STACK      0100 START      09C3 STKGOS     09C7 STKINP     0FAF STKLMT
030F STOP       079C SUBDE      07CA SV1        01F9 TAB1       021A TAB2
027F TAB4       02B1 TAB5       02B7 TAB6       02BF TAB8       012F TC1
013A TC2        0143 TN1        013E TSTNUM     0103 TSTV1      011F TV1
0124 TV1A       09D7 TXTBGN     0F00 TXTEND     09D5 TXTUNF     0761 USR
0780 USRET      0F00 VARBGN     09C5 VARNXT     071F WAITCM     09B3 WAITIO
0175 WHAT       0015 WRITED     03D1 WRITMOR    05D8 XP11       05DE XP12
05E4 XP13       05EB XP14       05F3 XP15       05F9 XP16       05FF XP17
0601 XP18       061F XP21       0622 XP22       0625 XP23       062C XP24
063D XP25       0640 XP26       064D XP31       0669 XP32       0671 XP33
067C XP34       0699 XP35       06AD XP40       06B6 XP41       06C3 XP42
06C4 XP43
```

Chapter 3

NIBL—National's Tiny Basic Language for SC/MP

By Phil Roybal and Mark Alexander

Since the birth of the first computing machines, users have sought simple ways to build the programs to drive them. While hardware technology advanced by leaps and bounds in the 50's and 60's, man-machine communication struggled painfully forward from patch panels to switch arrays and machine code programming. Finally the first crude assembler, child of a desperate engineer turned programmer, gave promise that users would someday "talk" with their machines in a mutually intelligible language.

Devices available today will allow a computer to identify spoken words and to respond vocally. But it will be a long time before the average hobbyist or industrial user will be able to describe a problem to his computer in common prose and expect any sort of intelligent response. The closest thing to this programmer's dream today is the high-level language: typically a simple, limited vocabulary of written English words in a rigidly defined grammer. The BASIC programming language is a typical example. The high-level language is usually implemented in a translation program (either compiler or interpreter) that analyzes each source code input statement and then expresses it as a series of machine language commands. High-level languages offer these advantages to their users:

- LEGIBILITY—High-level language statements are much easier to read and write than are their assembly language equivalents. This simplifies program construction, debug, and documentation.
- SPEED OF PROGRAMMING—Each statement expands into five to ten machine code commands; thus a high-level language program-

mer can write a program much more quickly than can an assembly language programmer who must generate the same amount of code.
- TRANSPORTABILITY—Programs written in a high-level language are (to some extent) machine independent. Thus code written for one processor can often be used on an entirely different processor with only minor modification.

Of course nothing comes for free, and the advantages of high-level languages have their price. Programs written in them can take 50% to 200% more memory for their operation; and they often execute much more slowly than equivalent assembly language programs. Until quite recently these drawbacks restricted the use of high-level languages to systems where frequent reprogramming was the rule, and some loss of performance was tolerable. They rarely appeared in production computer systems which had to be reproduced in quantity; and they weren't used with microprocessors, which were devoted almost exclusively to the control of such systems. But several things have happened over the last two years to change all that.

First, microprocessors, memories, and related hardware have become simple and inexpensive enough to appeal to the hobbyist, who tends to spend his time programming. He is not interested in production economies since he rarely builds more than one or two systems. But he is highly receptive to tools that make his programming chores easier and more fun.

Second, microprocessor technology has begun to penetrate non-traditional industries. In these new application areas potential users not only have not used programmed logic before, but some have never used electronic components, let alone microcomputers. They have built mechanical and fluid control systems, where the control algorithms were defined by levers and pipes. But they have little electronic experience, and no programming experience at all. They need programming tools that are easy to understand and to use; and they are willing to part with some system speed and economies to get them.

These forces have spurred the development of high-level languages for microprocessors. Thus, when National brought out SC/MP and aimed it at the low-end control market, hobbyists, and non-traditional users, some kind of high-level language seemed like a necessity. And when TINY BASIC a limited version of the standard BASIC language began to gain wide acceptance among hobbyists as a game and control language for microprocessors began to look like a good all around language choice.

For a language to be really useful on microprocessors, it must be good for digital input/output and device control as well as for games and text manipulation. TINY BASIC, developed as a games language, needed improvement in the I/O area. So a series of extensions to the hobbyist standard TINY BASIC were defined and built. Thus was born National Industrial Basic Language: NIBL (pronounced "Nibble") for short. The objectives for the NIBL language were as follows:

- To be a vehicle for rapidly building and evaluating control algorithms.
- To be a simple "self-teaching" approach to the understanding of microprocessors.
- To make use of numerous TINY BASIC games and control programs already in the public domain.
- To be a tool for quickly programming low-volume, moderate-speed application systems.
- To be easily expandable by National and by the user.

TINY BASIC, as originally conceived and written, was an interpreter—a translator that executes source code statements directly, one at a time, without first translating the user's entire program into machine language as compilers do. This approach has the advantage of easier source code manipulation (because the source is always available), and instant feedback of simple grammatical errors. The interpretive approach was retained in NIBL.

Since the original TINY BASIC language was intended to be adapted for many microprocessors, it was itself written interpretively in an ideal language (IL), designed expressly for the construction of translators. Thus, to adapt the language for SC/MP, it was necessary only to construct a simple interpreter that allowed the IL to execute on SC/MP as depicted in the NIBL symbolic concept, Figure 1. The generalized, already written TINY BASIC interpreter would then be usable on SC/MP. This multi-layered, onion-like approach gains two things: the IL interpreter for the NIBL interpreter is smaller and simpler to write than an interpreter for all of NIBL, so the initial investment to produce the product is reduced.

Secondly, since most of NIBL is programmed in a highly efficient instruction set especially tailored for writing translators, the interpreted NIBL is smaller than direct coding would allow. Thus we trade off execution speed for memory efficiency. Though all this sounds complex in the telling, it is invisible to the user, so it doesn't matter to most people.

NIBL LANGUAGE

Language conventions and operating information are shown in the following NIBL Quick Reference Guide. This is a summary of the legal commands and statements of NIBL.

Input Line Format and Editing

- Lines without numbers executed immediately.
- Lines with numbers inserted (in sequence) in program.
- Line number alone (empty line) deletes line.
- Blanks are meaningless, but key words must not contain blanks.
- CONTROL/U deletes current line.
- CONTROL/C aborts program, returns to command mode.
- "←" deletes last character typed.
- CARRIAGE RETURN terminates a line.

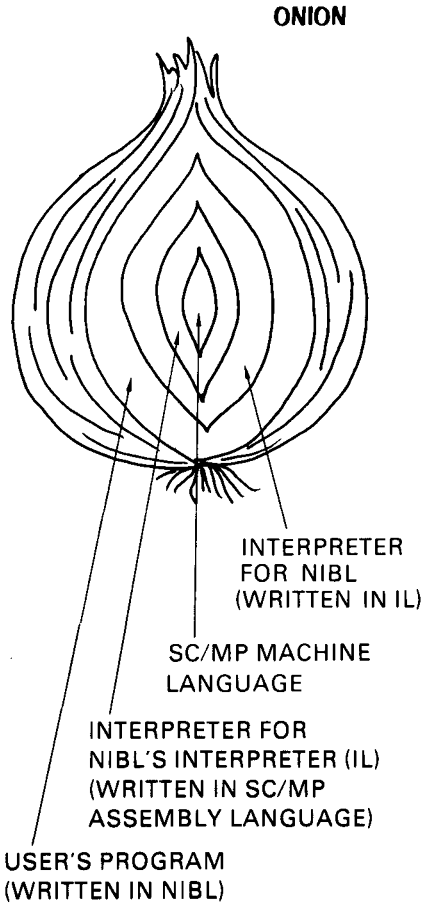

ONION
INTERPRETER FOR NIBL (WRITTEN IN IL)
SC/MP MACHINE LANGUAGE
INTERPRETER FOR NIBL'S INTERPRETER (IL) (WRITTEN IN SC/MP ASSEMBLY LANGUAGE)
USER'S PROGRAM (WRITTEN IN NIBL)

Figure 1. The NIBL Concept. NIBL, an interpreter, is written in an ideal language (IL), which is itself interpreted by a program written in SC/MP assembly language. (Diagram by permission of Dr. Dobb's Journal.)

Commands

CLEAR deletes all program information
RUN runs program
LIST lists program
LIST X lists program from line X on
GOTO X runs program from line X on
PAGE = X selects 4K byte user page X
NEW clears program but not variable assignments from the selected page.

Statements

Input/Output Statements

```
PRINT X,Y,Z
PRINT "THE ANSWER IS," X
INPUT X,Y,Z
aL=1
J=aL
```

Assignment Statements

```
LET X=3
LET X= -15+5*Y
```

Control Statements

```
GOTO X+10
GOTO 10
GOSUB Y+15
RETURN
IF X=Y THEN GOTO 15
DO: A=A+1: PRINT A: UNTIL A=10
FOR B=2 TO 20 STEP 2
....
....   NEXT B
....
REM THIS IS A COMMENT LINE
END Ends a program
LINK 5000
```

Variables

A.....Z (26 only)

Constants

Numbers

Decimal 0.....9
HEX 0.....F
All arithmetic is module 2^{15} (±32768)

Operators

Arithmetic	Relational	Logical
+ −	>>=	OR
*/	<<=	AND
	=<>	NOT

NIBL GRAMMAR

As originally defined, TINY BASIC had the grammatical elements indicated by the asterisk sign (*) in the text margin. While this grammar is adequate for a variety of games and internal data manipulations, it can be improved considerably for control applications through the addition of the rest of the elements shown in the following:

```
NIBL LINE = IMMEDIATE STATEMENT
          ! PROGRAM LINE
          ! INPUT RESPONSE ;
IMMEDIATE STATEMENT =
(COMMAND ! STATEMENT) CARRIAGE RETURN ;
PROGRAM LINE =(DECIMAL NUMBER STATEMENT LIST
          CARRIAGE RETURN) ;
INPUT RESPONSE =REL EXP (‘,‘ REL EXP) * CARRIAGE
          RETURN ;
  COMMAND = ‘NEW’
*   ! ‘CLEAR’
*   ! ‘LIST’ DECIMAL NUMBER?
*   ! ‘RUN’
*   ! ‘PAGE’
    ;
  STATEMENT LIST = STATEMENT
    ‘;’ STATEMENT) * ;
* STATEMENT = ‘LET’ ? (VARIABLE ! ‘STAT’ ! ‘a’ FACTOR)
    ‘=’ REL EXP
*   ! ‘GO’ (‘TO’ ! ‘SUB’) REL EXP
*   ! ‘RETURN’
*   ! (‘PR’ ! ‘PRINT’) PRINTLIST
*   ! ‘IF’ REL EXPR ‘THEN’ ? STATEMENT
*   ! ‘DO’
    ! ‘UNTIL’ REL EXP
    ! ‘FOR’ VARIABLE ‘=’ REL EXP ‘TO’ REL EXP
                                    (‘STEP’ REL EXP) ?
    ! ‘NEXT’ VARIABLE
*   ! ‘INPUT’ VARIABLE +
    ! ‘LINK’ REL EXP
    ! ‘REM’ ANY CHARACTER EXCEPT CARRIAGE
      RETURN
*   ! ‘END’
    ;
  REL EXPR = EXPRESSION RELOP EXPRESSION
    ! EXPRESSION
    ;
*   RELOP = ‘<’
*   ! ‘<’‘=’
*   ! ‘<’‘>’
*   ! ‘>’
*   ! ‘>’‘=’
*   ! ‘=’
    ;
    EXPRESSION = EXPRESSION ADDING
      OPERATOR TERM
    ;
      ADDING OPERATOR = ' + ' ! ' – '
        !  'OR' ;
  TERM = TERM MULTIPLYING OPERATOR FACTOR
        !  FACTOR
        ;
* MULTIPLYING OPERATOR = '*' ! '/'
        !  'AND' ;
    *   FACTOR = VARIABLE
    *   !  DECIMAL NUMBER
    *   !  '<' REL EXPR '>'
        !  'a' FACTOR
        !  '#' HEX NUMBER
        !  'NOT' FACTOR
        !  'RND' '<' REL EXP ',' REL EXP '>'
        !  'STAT'
        !  'TOP'
        ;
    *   VARIABLE = 'A' ! 'B' ! 'C' ! . . . ! 'Y' ! 'Z' ;
    *   DECIMAL NUMBER = DECIMAL DIGIT  +  ;
    *   DECIMAL DIGIT = '0' ! '1' ! '2' ! . . . ! '9' ;
        HEX NUMBER = (DECIMAL DIGIT ! HEX DIGIT) +
        HEX DIGIT = 'A' ! 'B' ! 'C' ! 'D' ! 'E' ! 'F' ;
        PRINTLIST = (STRING ! REL EXPR) (STRING ! REL
           EXPR) * ';' ? ;
        STRING = '"' ALMOST ANY CHARACTER '"'
```

NOTE: ALL ITEMS IN SINGLE QUOTES ARE ACTUAL SYMBOLS IN NIBL; ALL OTHER IDENTIFIERS ARE SYMBOLS IN THE GRAMMAR. THE EQUALS SIGN (=) MEANS "IS DEFINED AS"; PARENTHESES ARE USED TO GROUP SEVERAL ITEMS TOGETHER AS ONE ITEM; THE EXCLAMATION POINT (!) MEANS AN EXCLUSIVE-OR-CHOICE BETWEEN THE ITEMS ON EITHER SIDE OF IT; THE ASTERISK (*) MEANS ZERO OR MORE OCCURRENCES OF THE ITEM TO ITS LEFT; THE PLUS SIGN (+) MEANS ONE OR MORE REPETITIONS; THE QUESTION MARK (?) MEANS ZERO OR ONE OCCURRENCES; AND THE SEMICOLON (;) MARKS THE END OF A DEFINITION.

IN NIBL, SPACES ARE NOT SIGNIFICANT EXCEPT WITHIN THE SYMBOLS IN SINGLE QUOTES IN THE GRAMMAR ABOVE. NUMBERS AND RESERVED WORDS LIKE 'PRINT' OR 'GO' MUST NOT HAVE SPACES WITHIN THEM. A VARIABLE MUST BE FOLLOWED IMMEDIATELY BY A NON-ALPHABETIC CHARACTER IN ORDER TO DISTINGUISH IT FROM A KEY WORD.

System Requirements

The NIBL interpreter is intended to be a ROM-resident program in the first 4K of the SC/MP Memory address space (although it will run just as well in RAM). The interpreter requires at least 2K bytes of RAM starting at address 1000 (base 16), of which the interpreter uses nearly 300 bytes for stacks, variables, etc., leaving the rest for the user's program. Another 2K bytes of memory may be added to fill up this 4K page, forming what is hereafter referred to as "Page 1."

The SC/MP architecture forces memory to be split into pages of 4K bytes each; therefore, NIBL allows seven such pages to be used for storing programs. NIBL programs in the seven pages are edited separately, but may be linked together during program execution by special NIBL statements described in the following pages. Page #1 as mentioned above, must be RAM since the interpreter uses part of it as temporary storage; the part used to store application programs starts at location 111E (base 16).

The other six pages of memory, each of which starts at location n000 (base 16), where n is the page number, may be either RAM or ROM. Page 2 is a special page: it can contain a NIBL program to be executed immediately upon powering up the NIBL system.

The memory organization of NIBL is shown in Figure 2.

Throughout this article, the assumption is made that the user has a teletype with paper tape reader and punch, as with the SC/MP Low Cost Development System (LCDS). In fact, NIBL was designed to use the SC/MP LCDS teletype interface, but to be completely independent of the LCDS firmware. If NIBL is to be run on its own, the system should have the same configuration for the teletype, with the reader relay being operated directly by the SC/MP. At present, paper tape is the only medium for saving NIBL programs, but as soon as the hardware and software for SC/MP cassette interface become available, NIBL will be able to link to routines for saving and loading programs with ease.

Since the teletype interface is not based on a UART, the terminal baud rate can only be changed by modifying the time delays in NIBL's I/O routines. NIBL has been run successfully at 1200 baud with a CRT terminal; the assembly listing of the NIBL program is programmed for a 110 baud rate system.

Communicating with NIBL

When the NIBL system is ready to accept input, it prompts at the teletype with a ">" prompt sign. (NIBL is now in "edit mode.") The user then enters a line terminated by a carriage return. There are several special characters that are used to edit lines as they are typed:

Shift/O (back-arrow) causes the last character type to be deleted.

Control/H (backspace) performs the same function as shift/O, but echoes as a backspace/space/backspace sequence, which is only useful if the teletype routines are modified to run at high baud rates for use with CRT's.

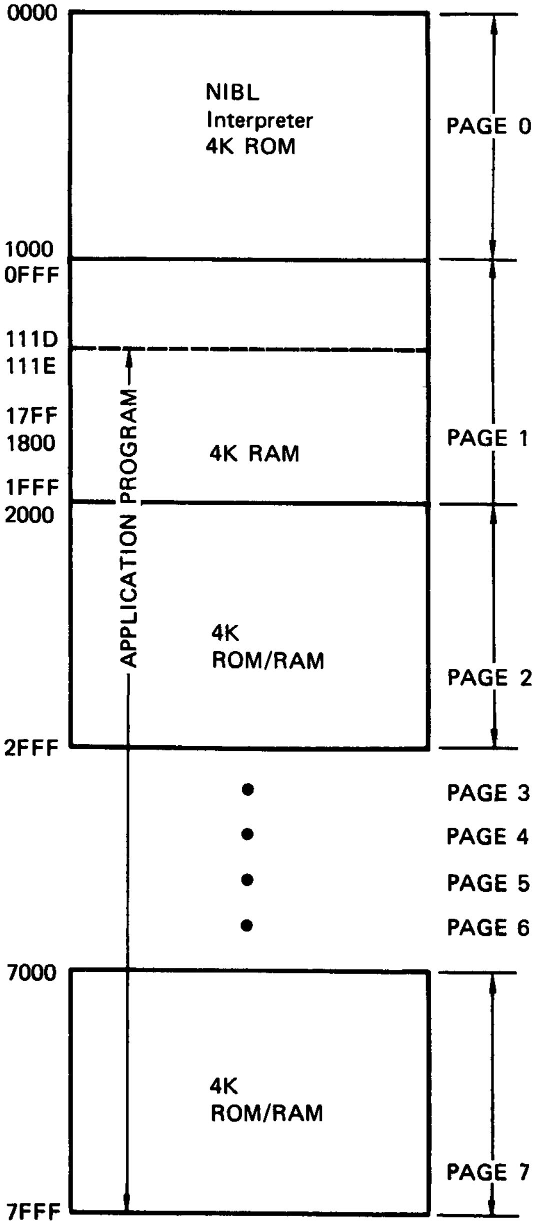


Figure 2. NIBL Memory Organization

Control/U (echoes as "'U") causes the entire line to be deleted; NIBL reprompts for a new line.

Entering a line to NIBL without a leading line number causes the line to be executed directly by NIBL. Most NIBL statements, as well as the four program control commands, may be executed in this manner.

A line with a leading number (in the range 0 through 32767) is entered into the NIBL program in the current page. (Make sure that the value of the pseudo-variable PAGE is valid, so that the line isn't into non-existent memory.) The NIBL editor sorts the program lines as they are entered into ascending order by line number.

Typing a line number followed by a carriage return deletes that line from the program. Typing a line with the same number as an existing line's causes the new line to replace the old one in the program.

Each of the seven memory pages may contain a different program, separate from the rest. Editing the program in one page will not affect the other pages. To switch editing from one page to another, simply type PAGE = n, where n is the number of the new page.

Variables

There are twenty-six variable names in NIBL: the letters A through Z. They are all 16-bit binary variables, so they can be used to hold addresses as well as signed numeric data. Space for pre-declared variables is allocated for them in RAM when NIBL powers up.

Constants

NIBL allows either decimal or hexadecimal (base 16) constants to appear in expressions. Decimal constants must lie in the range 0 through 32767; the unary minus (" – ") is used to obtain negative values. The value –32768 is a valid NIBL integer, but it is not legal as it stands. To represent it, use –32767-1 or #8000 instead.

Hexadecimal constants are denoted by a pound sign ("#") followed by a string of hexadecimal digits (0-9, A-F). NIBL does not check for overrun in hex constants; consequently, only the 4 least significant digits of the hex digit string are kept.

Functions

NIBL includes three functions that may appear in any expression. These are described as follows:

RND (X, Y) returns a pseudo-random integer in the range X through Y, inclusive, where X and Y are arbitrary expressions. In order for the function to work properly, the value of Y – X should be positive and no greater than 32767.

MOD (X, Y) returns the absolute value of the remainder from X divided by Y (where X and Y are expressions).

TOP (with no arguments) returns the address of the first free byte in the memory page currently being edited or executed. In other words, it is the address of the last byte at the top of the current NIBL application program in the current page, plus one.

Pseudo-Variables

NIBL has two pseudo-variables in addition to the standard variables. These are STAT and PAGE. Both of these variables may appear on either side of an assignment statement.

STAT represents the SC/MP status register. The current value of the status register can be referred to by using STAT in an expression; or an assignment may be made to the status register by executing a statement such as STAT=4 or STAT=STAT OR #20. When NIBL makes an assignment to the status register in this manner, it clears the interrupt-enable bit of the value before it is actually assigned. Note also that only the lower byte of the value is assigned, the high byte is ignored.

The carry and overflow bits in STAT are meaningless since the NIBL system is continually modifying them. The utility of STAT lies in the fact that 5 of its bits are connected to I/O sense lines on the SC/MP chip.

The pseudo-variable PAGE contains the number of the memory page currently being executed or edited. As indicated in Figure 2, there are seven pages in which NIBL programs may be stored; therefore, the PAGE number may be only in the range of 1 through 7. If an assignment of a value outside this range is made to PAGE, only the 3 least significant bits LSBs of the value are used. Page one is defined as LSBs=000, page two as LSBs=001 etc.

If PAGE is modified while NIBL is in edit mode, all subsequent editing will take place in the new page.

If PAGE is modified by a NIBL program during execution, control will be passed to the first line of the NIBL program in the new page. This transfer would be effected by a statement such as PAGE=6 or PAGE=PAGE+1. Thus, several NIBL programs residing in different 4K pages may be linked together as one large program, if need be. This would allow one to write a 28K STAR TREK program in NIBL, a Herculean and indeed foolish task.

Control may also be transferred from one page to another by three other statements: RETURN, NEXT, and UNTIL. Thus, the first part of a subroutine or loop may be in one page, and the second part may be in another (with control being transferred between the two parts by an assignment to PAGE). In these three special cases, NIBL automatically updates the value of PAGE as the statements are executed.

Relational Operators

NIBL provides the standard BASIC relational operators, for comparing the values of integer expressions. The operators are as follows:

=	equal to
<=	less than or equal to
>=	greater than or equal to
<>	not equal to
<	less than
>	greater than

All of these operators produce 1 as a result if the relation is true, and 0 if the relation is false. Note that the relational operators may appear anywhere that an expression is called for in the NIBL grammar, not only in IF statements.

Arithmetic Operators

NIBL provides the four standard arithmetic functions: Addition (+), subtraction or unary minus (−), multiplication (*/), and division (/). Since only integers are allowed in NIBL, all quotients are truncated (the MOD function can be used to obtain remainders from division). Any overflow or underflow (other than division by zero) is ignored by NIBL; the reasoning behind this is that it may often be necessary to treat NIBL expressions as unsigned values, such as when performing calculations using memory addresses as the operands. Thus the value of 32767 + 1 is −32768 (or in hexadecimal, °7FFF + 1 = #8000, which makes more sense).

Logical Operators

In NIBL, there are three logical operations that may be performed on values; AND, OR, and NOT. The first two are binary operators, and the latter is unary. All three perform bitwise logical operations on 16-bit arguments, producing 16-bit results. AND, OR, and NOT are sufficient to simulate any other logical operation, through various combinations of the operators.

The Indirect Operator

The indirect operator "@" realizes the functions of PEEK and POKE operations in other BASICs, but with somewhat more elegance. The "@" sign followed by an address (which can be a constant, variable, or expression in parentheses) denotes the contents of that address in memory. Thus, if memory location 245 (decimal) contains 60, the statement X = @245 would result in the value 60 being assigned to X. The indirect operator may also appear on the left side of an assignment statement. For example, @X = @(Y + 10) would result in the memory location pointed to by X being assigned the value of the memory location pointed by the value Y + 10.

Use of the indirect operator is not limited to reading from or writing to memory: it also provides a simple way to communicate with peripheral devices that are interfaced to the SC/MP through memory addresses. Note that the "@" operator can only access memory one byte at a time, and that when an assignment is made to a memory location, only the low order byte of the value is moved to the location; the high order byte is ignored.

The indirect operator can also be used to simulate arrays in NIBL. For example, if we wish to define an M x N matrix of one-byte positive integers, we can access the (I,J)th element of the matrix (assuming that (0,0) is a legal element in the matrix) with the expression @(A + I * N + J). An assignment could be made to that same element by placing the expression on the left side of an assignment statement.

Expressions

Expressions in NIBL are composed of variables, constants, function references, pseudo-variables, and operators. Operators bind these other elements together to form complete expressions. NIBL expressions are all 16-bit integers. Evaluation of expressions takes place left-to-right, and the order in which operations take place is determined by operator precedence and the presence of parentheses. The order of evaluation can be deduced from the grammar in Table 1; here is a table of operator precedence:

Lowest precedence (applied last): <,>,<=,>=,=,
<>
+,−,OR
*,/,AND
Highest precedence (applied first): @, NOT

Despite this, it is still safest to use plenty of parentheses in expressions to make the intent clear.

Program Control Commands

LIST causes the entire program in the current page to be listed. Listing can be halted by hitting any key on the teletype: the BREAK Key works best.

LIST <number> causes listing to begin at the given line number (or the nearest one greater than the number), rather than at the first line.

LISTing a program is the method used to save it on paper tape. To accomplish this, type LIST with the punch off, then turn on the punch and hit carriage return. After the program is dumped, type a Shift/O with teletype on LOCAL so that the last character (a ">") will be deleted when the tape is entered to NIBL at a later time. NIBL will accept a tape made in this fashion at any time during edit mode. The tape reader is enabled at all times by NIBL, and it does not distinguish between the reader and the keyboard when accepting input. Superfluous line-feed and null characters on the tape are echoed but ignored.

RUN causes three actions: first, all variables are zeroed; secondly, all stacks (the FOR, DO, and GOSUB stacks) are cleared; and finally the program in the current page is executed, starting with the first line in sequence.

RUN is not the only way to start program execution: GOTO and GOSUB can also be used to jump into a program from edit mode. For example, if there is a subroutine at line 1000 that is being tested, typing GOSUB 1000 will cause that routine to be executed, with NIBL returning to edit mode upon encountering a RETURN statement. When GOTO and GOSUB are used to run a program, the variables and stacks are not cleared.

Hitting any key while a program is being run will cause NIBL to break execution, printing a message and the line number where the break was detected. The BREAK key on the teletype works best for this.

CLEAR causes all variables to be zeroed and the three stacks mentioned above to be cleared. This latter feature of the CLEAR command is quite useful after a stack nesting error has occurred (for example, if GOSUBs are nested more than eight levels deep).

NEW clears the program in Page 1, and changes the value of PAGE to 1. This is the form of the command most likely to be used by NIBL novices who do not wish to be confused by the page selection features of NIBL. NEW should be the first thing one types in to NIBL when first powering up.

NEW <number> sets the value of PAGE to the <number>, and clears the program in that page.

Assignment Statements

Previously, two different types of assignment statements have been described: assignments to the pseudo-variables STAT and PAGE, and assignments to memory locations with the indirect operator. Another form of the assignment statement is the conventional assignment to a variable (A = Z), e.g. A = A + 1 or A = 32<(4*I). There are also statements which look like string assignments, but these are not standard BASIC, and are described later in the section on string handling. The word "LET" is optional in front of any assignment statement (leaving it out increases execution speed, unlike most Tiny BASIC systems).

IF/THEN Statement

The IF statement allows conditional execution of one or more statements (as many as can fit on one line). The syntax for the IF statement is:

'IF' Rel-exp 'THEN'? Statement

which indicates that the word THEN is optional, and that any statement (including another IF statement) may follow the conditional expression. If the IF condition is true (i.e. is non-zero), the statement following it (and any others on the line) will be executed; otherwise, control immediately transfers to the next program line. The condition does not need to contain relational operators: a statement such as IF MOD (A,5) THEN. . . is perfectly legal. In this example, the statement following the THEN would be executed if A were not divisible by 5.

GOTO, GOSUB, and RETURN Statements

The syntax for the GOTO statement is 'GOTO' followed by an expression. The effect of the GOTO statement is to transfer control to the line whose number is indicated by the expression. An error occurs if the specific line does not exist in the current page. Unlike standard BASICs, any arbitrary expression can be used to specify the line number, as well as the usual decimal constant. This allows computed branches to be eprformed with the same effect as the ON. . .GOTO statement in standard BASIC.

The GOSUB statement is identical to the GOTO statement in form. It too causes a branch to a new line, but it also saves the address of the following statement on a stack. When a RETURN statement is executed, the saved address is popped from the stack, and control returns to that point in the program. Since an actual address, not a line number, is saved on the GOSUB stack, GOSUB statements may appear anywhere on a multiple-statement line.

GOSUBs may be nested up to eight levels deep; an error will occur if an attempt is made to exceed this limit. The error condition does not destroy the previous contents of the stack, so a RETURN statement can be executed (even in edit mode) without an error occurring. However, any modification of the NIBL program will clear the GOSUB stack, so that a subsequent RETURN without a GOSUB will cause an error.

DO and UNTIL Statements

The DO and UNTIL statements are useful in writing program loops efficiently, without using misleading GOTO statements. Enclosing a group of zero or more statements between a DO statement and an UNTIL <condition> statement (where <condition> is an arbitrary expression) will cause the statement group to be repeated one or more times until the <condition> becomes true (i.e. non-zero). As an example of the use of the DO and UNTIL statements, we present a program that prints the prime numbers:

```
 10 PRINT 1: PRINT 2
 20 I=3
 30 DO
 40 J=I/2: N=2
 50 DO
 60 N=N+2
 70 UNTIL (MOD (I,N)=0) OR (N>J)
 80 IF N>J PRINT I
 90 I=I+2
100 UNTIL 0
```

DO loops may be nested up to eight levels deep, and NIBL acts in the same manner if an overflow occurs as it does with a GOSUB overflow. NIBL also reports an error if an UNTIL statement occurs without a previous DO. A single DO loop may have more than one UNTIL statement as a terminator. For example, if one wished to exit abnormally out of a DO loop and transfer to some appropriate line, it could be done in the following manner:

```
UNTIL 1: GOTO X
```

where X is the line number.

Neither the DO nor the UNTIL statement may be executed in edit mode.

FOR and NEXT Statements

The NIBL FOR statement is virtually identical to that in standard BASICs; consequently, it is not explained in great detail here.

As in most BASICs, both positive and negative STEPs are allowed in the FOR statement, and a STEP of +1 is assumed if the STEP portion of the statement is omitted. A FOR Loop is terminated by a NEXT <variable> statement, and the <variable> must be the same as that referred to in the FOR statement at the beginning of the loop.

FOR loops may be nested four levels deep; NIBL reports an error if this limit is exceeded, or if a NEXT statement occurs without a previous FOR statement. As with the DO and UNTIL statements, FOR and NEXT may not be executed in edit mode.

Perhaps the only differences between the NIBL FOR statement and that of more elaborate BASICs (such as DEC's BASIC-PLUS for the PDP-11) are that a FOR Loop is always executed at least once, and that when a NEXT statement is executed, the STEP value is added to the variable before the test is made to determine if the loop should be repeated (rather than after the test).

INPUT Statement

There are two types of INPUT statements in NIBL: numeric input and string input. The form of the first type is 'INPUT' followed by a list of one or more variables. When this statement is executed, NIBL prompts at the teletype with a question mark ("?"). The user responds with a list of expressions separated by commas, and terminated by a carriage return. For example, a legal response to the statement INPUT A,B,C would be #3FA,26,4*27. These three expressions would then be assigned to the variables A,B, and C, respectively. An illegal response (too few arguments or improper expressions) will result in a syntax error. Any extra arguments in the response are ignored.

The second type of INPUT statement allows strings to be input. The form of the statement is "INPUT' '$' <address>, where <address> is a Factor, syntactically (usually a variable, constant, or expression in parentheses). When this statement is executed, NIBL prompts the user as before, at which point the user enters a line terminated by the usual carriage return. NIBL then stores the line in memory in consecutive locations, beginning at the address specified. Thus, INPUTS #6000 would cause the input line to be stored starting at location 6000 (base 16); the carriage return would also be stored at the end of the line.

Strings input in this manner can be tested and manipulated by using the "@" operator or the string handling statements described below. They can also be displayed by a PRINT statement.

Neither of the two INPUT statements may be executed in edit mode.

PRINT Statement

The form of the PRINT statement is 'PRINT' or 'PR' followed by a list of print items separated by commas, and optionally terminated by a semicolon, which suppresses an otherwise automatic carriage return after all items in the list are printed.

A print item consists of one of the following:

- A quoted string, which is printed exactly as it appears (with the quotes removed)
- An expression, which is evaluated and printed in decimal format, with either a leading space or a minus sign ("–"), and one trailing space
- A reference to a string in memory, denoted by '$' <address>, where <address> is a Factor as usual. Successive memory locations, starting at the specified address, are printed as ASCII characters, until a carriage return (which is not printed) is encountered.

There is no zone spacing in the PRINT statement, nor does NIBL perform an automatic carriage return/line feed after printing 72 characters. NIBL is not an output-oriented language; fancy formatting has been sacrificed for more useful control structures and data manipulation features. (A subroutine to print a number and skip to the next print zone is a trivial to write in NIBL—it takes about two lines of code, with the DO/UNTIL and FOR/NEXT.)

String Handling Statements

String handling in NIBL is very minimal and low-level. The string handling features of the INPUT and PRINT statements have already been mentioned; NIBL provides two more statements for manipulating strings.

A statement such as $<address>="THIS IS A STRING" would cause the quoted string to be stored in memory starting at the specified address (which again is a Factor), with a carriage return being appended to the string.

Another statement allows the programmer to move strings around in memory once they have been created. The form of this statement is '$' <destination> '=' '$' <source>, where both <destination> and <source> are Factors, and are the addresses of strings in memory. This statement causes all the characters in the string pointed to by <source> to be copied one-by-one to the memory pointed to by <destination>, until a carriage return (also copied) is encountered. Overlapping the source and destination addresses can produce disastrous results, such as wiping out the entire contents of the current page. Consequently, a string move can be aborted by hitting the BREAK key on the teletype (but it must be done quickly!).

Note that all strings referred to in these statements, and in the INPUT and PRINT statements, are assumed to lie within a 4K page, and wraparound is a possibility which must be anticipated by the programmer. (Long-time SC/MP programmers will be familiar with this minor problem.)

Using these statements, it should be very easy to develop a set of NIBL subroutines for performing concatenation, comparison, and substring operations on strings.

END Statement

The END statement may appear anywhere in a NIBL program and not necessarily at the end. It causes a message and the current line number to be printed, with NIBL returning to edit mode. The END statement is useful when debugging programs, since it acts as a breakpoint in the program that can be removed easily.

LINK Statement

The LINK statement allows NIBL programs to call SC/MP machine language routines at any address. A statement of the form 'LINK' <address>, where <address> is an arbitrary expression, will cause the NIBL system to call the routine at that address by executing an appropriate XPPC P3 (Exchange contents of the Program Counter with designated Pointer Register P3) instruction. The user's routine should make sure that it returns by executing another XPPC P3, and that the value of P3 (Pointer Register #3) upon entry to the routine is restored before returning. The routine may make use of the fact that P2 is set by NIBL to point to the beginning of the RAM block used to store the variables A through Z, with each variable being stored low byte first, high byte second. Thus, parameters may be passed between NIBL programs and machine language routines through the variables. Both P1 and P2 may be modified by the user's routines; they are automatically restored by the NIBL system upon return. The user should be careful not to modify RAM locations with negative displacements relative to P2, or the locations with displacements greater than 51 relative to P2. These locations are used by the interpreter.

Remark Statement

A comment can be inserted into a NIBL program by preceding it with the word REM, REM causes the rest of the line to be ignored by NIBL during execution. Remarks are useful in debugging programs or helping other people to understand them, but of course, they take up valuable memory. (Then again, memory is getting cheaper all the time.)

Multiple Statements On One Line

A program line may contain more than one statement, if the statements are separated by colons (";"). Using multiple statements on a single line improves the readability of the program by separating it into small blocks, and uses less memory for storing the program.

It is important to note that an IF statement will cause any statements appearing after it on the line to be ignored if the IF condition turns out to be false. This is the feature that allows a group of statements to be executed conditionally.

A multiple-statement line may be entered without a line number, but NIBL will only execute the first statement on the line, ignoring the rest.

NIBL Applications

Most users sitting at a NIBL terminal for the first time will want to start playing games with the machine. There seems to be nothing like the thrill of having some quasilogical conversation with, and being soundly beaten by, a computer. TINY BASIC was originally built to implement games; and it performs well in this mode. An example of a simple NIBL game which will illustrate the flavor of the language is shown in Listing 1.

Listing 1. "Bagels"—A Simple NIBL Game

```
 10 PRINT "      BAGELS":
    PRINT "":
    PRINT ""
 40 PRINT " I WILL THINK OF A THREE DIGIT NUMBER. YOU TRY TO"
 50 PRINT " GUESS WHAT IT IS.  FOR EACH CORRECT DIGIT IN THE"
 53 PRINT " CORRECT LOCATION, I WILL PRINT 'FERMI'.  FOR EACH"
 55 PRINT " CORRECT DIGIT NOT IN THE CORRECT LOCATION, I WILL"
 57 PRINT " PRINT 'PICO'.  IF NO DIGITS ARE CORRECT, I WILL PRINT"
 58 PRINT " 'BAGLES'. ":
    PRINT "":
    PRINT ""
 59 REM
 60 A=RND(1,9):
    B=RND(0,9):
    C=RND(0,9):
    P=0
 70 REM SELECT A NUMBER
 71 REM
120 PRINT " PLEASE GUESS A THREE DIGIT NUMBER. ";
130 INPUT G:
    REM INPUT GUESS,TEST RANGE
135 REM
140 IF G> 1000 OR G<100 GOTO 120
160 M=0:
    N=0:
    P=P+1:
    H=G/100:
    REM ZERO CNTRS, SELECT LEFT DIGIT
200 IF H=A M=M+1:
      REM CORRECT DIGIT & LOCATION
210 IF ((H=B) OR (H=C)) N=N+1:
      REM CORRECT DIGIT, BAD LOCATION
230 I=MOD(G,100)/10:
    REM SELECT MID. DIGIT OF INPUT
 240 IF ((I=A) OR (I=C)) N=N+1:
       REM CORRECT DIGIT, BAD LOCATION
 250 IF I=B M=M+1:
       REM CORRECT DIGIT & LOCATION
 270 J=MOD(G,10):
     REM SELECT RIGHT DIGIT OF INPUT
 280 IF ((J=A) OR (J=B)) N=N+1:
       REM CORRECT DIGIT, BAD LOCATION
 300 IF J=C M=M+1:
       REM CORRECT DIGIT & LOCATION
 310 IF M<3 GOTO 600
 320 PRINT " CONGRATULATIONS! YOU GOT IT IN", P ,"TRIES. "
 330 PRINT " PLAY AGAIN ?  (1=YES, 0=NO )"
 340 INPUT Q:
     IF Q=0 GOTO 1000
 360 GOTO 60
 500 REM
 550 REM NEXT SECTION PRINTS CLUES
 600 IF M<>0
       FOR T=1 TO M:
         PRINT "FERMI  ";:
       NEXT T
 620 IF N<>0
       FOR T=1 TO N:
         PRINT "PICO  ";:
       NEXT T
 650 IF M+N =0 PRINT "BAGLES"
 700 PRINT "":
     GOTO 120:
     REM ASK FOR NEXT GUESS
1000 PRINT "GOODBYE"
```

The object of the game is to guess the number that the microprocessor has picked. All numbers are between 100 and 999. For each correctly guessed digit in the correct location, the processor responds "FERMI." For each correct digit not in the right location, the processor responds "PICO." If no correct digits are guessed, the processor responds "BAGLES."

The NIBL Language is well suited to control tasks, as long as the user recognizes its inherent speed limitations. While it is more than adequate for human interface and a variety of other control applications, it doesn't have the speed to handle video generation, direct control of fast peripherals, etc. For these applications, the algorthims should be proved out in NIBL, then translated into SC/MP machine code for installation in the final system. On the plus side, once the user has paid the initial price in speed and ROM for the interpreter, he will find that NIBL tasks (which are stored as powerful source statements) tend to take less memory than their assembly language equivalents. The larger the program, the more dramatic are the savings.

Bibliography

DR. DOBB'S JOURNAL OF COMPUTER CALISTHENICS AND ORTHODONTIA; Volume 1, No. 1—January, 1976. PCC, Box 310, Menlo Park, CA 94025.

And thanks to Dr. Marvin Winzinread, California State University at Hayward, for "BAGLES."

```

0001            LIST    1

        ;****************************************************
        ;*                                                  *
        ;*      WE ARE TIED DOWN TO A LANGUAGE WHICH        *
        ;*      MAKES UP IN OBSCURITY WHAT IT LACKS         *
        ;*      IN STYLE.                                   *
        ;*                      -- TOM STOPPARD             *
        ;*                                                  *
        ;****************************************************

0020    TSTBIT  =       020             ;I. L.  INSTRUCTION FLAGS
0040    JMPBIT  =       040
0080    CALBIT  =       080
0001    P1      =       1               ;SC/MP POINTER ASSIGNMENTS
0002    P2      =       2
0003    P3      =       3
FF80    EREG    =       -128            ;THE EXTENSION REGISTER

        ; DISPLACEMENTS FOR RAM VARIABLES USED BY INTERPRETER

FFFF    DOPTR   =       -1              ;DO-STACK POINTER
FFFE    FORPTR  =       -2              ;FOR-STACK POINTER
FFFD    LSTK    =       -3              ;ARITHMETIC STACK POINTER
FFFC    SBRPTR  =       -4              ;GOSUB STACK POINTER
FFFB    PCLOW   =       -5              ;I. L.  PROGRAM COUNTER
FFFA    PCHIGH  =       -6
FFF9    PCSTK   =       -7              ;I. L.  CALL STACK POINTER
FFF8    LOLINE  =       -8              ;CURRENT LINE NUMBER
FFF7    HILINE  =       -9
FFF6    PAGE    =       -10             ;VALUE OF CURRENT PAGE
FFF5    LISTNG  =       -11             ;LISTING FLAG
FFF4    RUNMOD  =       -12             ;RUN/EDIT FLAG
FFF3    LABLLO  =       -13
FFF2    LABLHI  =       -14
FFF1    P1LOW   =       -15             ;SPACE TO SAVE CURSOR
FFF0    P1HIGH  =       -16
FFEF    LO      =       -17
FFEE    HI      =       -18
FFED    FAILLO  =       -19
FFEC    FAILHI  =       -20
FFEB    NUM     =       -21
FFEA    TEMP    =       -22
FFE9    TEMP2   =       -23
FFE8    TEMP3   =       -24
FFE7    CHRNUM  =       -25
FFE6    RNDF    =       -26
FFE5    RNDX    =       -27             ;SEEDS FOR RANDOM NUMBER
FFE4    RNDY    =       -28

         ; ALLOCATION OF RAM FOR NIBL VARIABLES, STACKS,
         ;   AND LINE BUFFER

```

```
0000                    .=01000+28
101C         VARS:      .=.+52                  ; NIBL VARIABLES A-Z
1050         AESTK:     .=.+26                  ; ARITHMETIC STACK
106A         SBRSTK:    .=.+16                  ;GOSUB STACK
107A         DOSTAK:    .=.+16                  ;DO/UNTIL STACK
108A         FORSTK:    .=.+28                  ;FOR/NEXT STACK
10A6         PCSTAK:    .=.+48                  ;I.L. CALL STACK
10D6         LBUF:      .=.+74                  ;LINE BUFFER
1120         PGM:       .=0                     ;USER'S PROGRAM

                        .MACRO  LDPI,P,VAL
                        .MLOC   TEMP
                        .SET    TEMP,VAL
                        LDI     H(TEMP)
                        XPAH    P
                        LDI     L(TEMP)
                        XPAL    P
                         ENDM


             ;************************************
             ;*       INITIALIZATION OF NIBL      *
             ;************************************


0000 08                 NOP
0001                    LDPI    P2,VARS         ;POINT P2 AT VARIABLES
0007                    LDPI    P1,PGM          ;POINT P1 AT PAGE ONE PROGRAM
000D C4FF               LDI     -1              ;STORE -1 AT START OF PROGRAM
000F C900               ST      0(P1)
0011 C901               ST      1(P1)
0013 C40D               LDI     0D              ;ALSO STORE A DUMMY END-OF-LI
0015 C9FF               ST      -1(P1)
0017 C402               LDI     2               ;POINT P2 AT PAGE 2,
0019 CAF6               ST      PAGE(P2)        ; INITIALLY SET PAGE TO 2
001B 31                 XPAL    P1
001C C420               LDI     020
001E 35                 XPAH    P1
001F B902               DLD     2(P1)           ;CHECK IF THERE IS REALLY
0021 01                 XAE                     ; A PROGRAM IN PAGE 2:
0022 C180               LD      EREG(P1)        ; IF FIRST LINE LENGTH
0024 E40D               XRI     0D              ; POINTS TO CARR. RETURN
0026 9802               JZ      $0              ; AT END OF LINE
0028 BAF6               DLD     PAGE(P2)        ;IF NOT, PAGE = 1
002A C420    $0:        LDI     020
002C 35      $LOOP:     XPAH    P1
002D C4FF               LDI     -1              ;STORE -1 IN 2 CONSECUTIVE
002F C900               ST      (P1)            ; LOCATIONS AT START OF PAGE
0031 C901               ST      1(P1)
0033 C40D               LDI     0D              ;ALSO PUT A DUMMY END-OF-LINE
0035 C9FF               ST      -1(P1)          ; JUST BEFORE TEXT
0037 35                 XPAH    P1              ;UPDATE P1 TO POINT TO
0038 02                 CCL                     ; NEXT PAGE (UNTIL PAGE=8)
0039 F410               ADI     010             ;REPEAT INITIALIZATION
003B E480               XRI     080             ; FOR PAGES 2-7
003D 9804               JZ      $1
003F E480               XRI     080
0041 90E9               JMP     $LOOP
0043 C400    $1:        LDI     0               ;CLEAR SOME FLAGS
0045 CAF4               ST      RUNMOD(P2)
0047 CAF5               ST      LISTNG(P2)
0049 C454               LDI     L(BEGIN)        ;INITIALIZE IL PC SO THAT
004B CAFB               ST      PCLOW(P2)       ; NIBL PROGRAM
004D C40C               LDI     H(BEGIN)        ; IS EXECUTED IMMEDIATELY
004F CAFA               ST      PCHIGH(P2)
0051 C400    CLEAR:     LDI     0
0053 CAEA               ST      TEMP(P2)
0055 01                 XAE
0056 C400    CLEAR1:    LDI     0               ;SET ALL VARIABLES
0058 CA80               ST      EREG(P2)        ; TO ZERO
005A AAEA               ILD     TEMP(P2)
005C 01                 XAE
005D C434               LDI     52
```

```
005F 60                XRE
0060 9CF4              JNZ     CLEAR1
0062 C450              LDI     L(AESTK)            ;INITIALIZE SOME STACKS:
0064 CAFD              ST      LSTK(P2)            ; ARITHMETIC STACK,
0066 C47A              LDI     L(DOSTAK)
0068 CAFF              ST      DOPTR(P2)           ; DO/UNTIL STACK,
006A C46A              LDI     L(SBRSTK)
006C CAFC              ST      SBRPTR(P2)          ; GOSUB STACK,
006E C4A6              LDI     L(PCSTAK)
0070 CAF9              ST      PCSTK(P2)           ; I.L. CALL STACK,
0072 C48A              LDI     L(FORSTK)
0074 CAFE              ST      FORPTR(P2)          ; FOR/NEXT STACK



                ;***********************************
                ;*   INTERMEDIATE LANGUAGE EXECUTOR  *
                ;***********************************

0076 C2FB      EXECIL: LD      PCLOW(P2)           ;SET P3 TO CURRENT
0078 33                XPAL    P3                  ; IL PC.
0079 C2FA              LD      PCHIGH(P2)
007B 37                XPAH    P3
007C C701      CHEAT:  LD      @1(P3)
007E 01                XAE                         ;GET NEW IL INSTRUCTION
007F C701              LD      @1(P3)              ; INTO P3 THROUGH
0081 33                XPAL    P3                  ; OBSCURE METHODS
0082 CAFB              ST      PCLOW(P2)           ;SIMULTANEOUSLY, INCREMENT
0084 40                LDE                         ; THE IL PC BY 2
0085 37                XPAH    P3
0086 CAFA              ST      PCHIGH(P2)
0088 40                LDE
0089 D4F0              ANI     0F0                 ;CHECK IF IL INSTRUCTION
008B E420              XRI     TSTBIT              ; IS A 'TEST'
008D 9836              JZ      TST
008F E4A0              XRI     CALBIT!TSTBIT       ;CHECK FOR IL CALL
0091 980D              JZ      ILCALL
0093 E4C0              XRI     JMPBIT!CALBIT       ;CHECK FOR IL JUMP
0095 9C06              JNZ     NOJUMP
0097 37                XPAH    P3                  ;*** I.L. JUMP ***
0098 D40F              ANI     0F                  ;ALL IT TAKES IS SCRUBBING
009A 37                XPAH    P3                  ; THE JUMP FLAG OFF OF P3
009B 90DF      CHEAT1: JMP     CHEAT
009D 3F        NOJUMP: XPPC    P3                  ;MUST BE AN ML SUBROUTINE
009E 90D6              JMP     EXECIL              ; IF NONE OF THE ABOVE



                ;***********************************
                ;*    INTERMEDIATE LANGUAGE CALL     *
                ;***********************************

00A0 C2F9      ILCALL: LD      PCSTK(P2)
00A2 E4D6              XRI     L(LBUF)             ;CHECK FOR STACK OVERFLOW
00A4 9C04              JNZ     ILC1
00A6 C40A              LDI     10
00A8 9063              JMP     EOA
00AA E4D6      ILC1:   XRI     L(LBUF)             ;RESTORE ACCUMULATOR
00AC 33                XPAL    P3                  ;SAVE LOW BYTE OF NEW
00AD CAEA              ST      TEMP(P2)            ; I.L. PC IN TEMP
00AF C410              LDI     H(PCSTAK)           ;POINT P3 AT I.L.
00B1 37                XPAH    P3                  ; SUBROUTINE STACK
00B2 C2FB              LD      PCLOW(P2)           ;SAVE OLD I.L. PC ON STACK
00B4 CF01              ST      @1(P3)
00B6 C2FA              LD      PCHIGH(P2)
00B8 CF01              ST      @1(P3)
00BA C2EA              LD      TEMP(P2)            ;GET LOW BYTE OF NEW
00BC 33                XPAL    P3                  ; I.L. PC INTO P3 LOW
00BD CAF9              ST      PCSTK(P2)           ;UPDATE I.L. STACK POINTER
00BF 40                LDE                         ;GET HIGH BYTE OF NEW P3
00C0 D40F              ANI     0F                  ; I.L. PC INTO P3 HIGH
00C2 37                XPAH    P3
00C3 90B7              JMP     CHEAT


```

```
                  ;*************************************
                  ;*       I.L. 'TEST' INSTRUCTION      *
                  ;*************************************

                           LOCAL
00C5 CAE7   TST:     ST      CHRNUM(P2)      ;CLEAR NUMBER OF CHARS SCANNE
00C7 C501   $SCAN:   LD      @1(P1)          ;SLEW OFF SPACES
00C9 E420            XRI     ' '
00CB 98FA            JZ      $SCAN
00CD C5FF            LD      @-1(P1)         ;REPOSITION CURSOR
00CF C2FA            LD      PCHIGH(P2)      ;POINT P3 AT IL TABLE
00D1 37              XPAH    P3
00D2 D40F            ANI     0F              ;FAIL ADDRESS <- OLD P3
00D4 CAEC            ST      FAILHI(P2)
00D6 C2FB            LD      PCLOW(P2)
00D8 33              XPAL    P3
00D9 CAED            ST      FAILLO(P2)
00DB C701   $LOOP:   LD      @1(P3)
00DD 01              XAE                     ;SAVE CHAR FROM TABLE
00DE BAE7            DLD     CHRNUM(P2)      ;DECREMENT CHAR COUNT
00E0 40              LDE                     ;GET CHAR BACK
00E1 D47F            ANI     07F             ;SCRUB OFF FLAG (IF ANY)
00E3 E501            XOR     @1(P1)          ;IS CHAR EQUAL TO TEXT CHAR?
00E5 9C07            JNZ     $NEQ            ;NO - END TEST
00E7 40              LDE                     ;YES - BUT IS IT LAST CHAR?
00E8 94F1            JP      $LOOP           ;IF NOT, CONTINUE TO COMPARE
00EA 9090            JMP     CHEAT           ;IF SO, GET NEXT I.L.
00EC 9088   X0:      JMP     EXECIL          ; INSTRUCTION
00EE C2E7   $NEQ:    LD      CHRNUM(P2)      ;RESTORE P1 TO
00F0 01              XAE                     ; ORIGINAL VALUE
00F1 C580            LD      @EREG(P1)
00F3 C2ED            LD      FAILLO(P2)      ;LOAD TEST-FAIL ADDRESS
00F5 33              XPAL    P3              ; INTO P3
00F6 C2EC            LD      FAILHI(P2)
00F8 37              XPAH    P3
00F9 90A0            JMP     CHEAT1          ;GET NEXT IL INSTRUCTION


                  ;*************************************
                  ;*       I.L. SUBROUTINE RETURN       *
                  ;*************************************

00FB C410   RTN:     LDI     H(PCSTAK)       ;POINT P3 AT I.L. PC STACK
00FD 37              XPAH    P3
00FE C2F9            LD      PCSTK(P2)
0100 33              XPAL    P3
0101 C7FF            LD      @-1(P3)         ;GET HIGH PART OF OLD PC
0103 01              XAE
0104 C7FF            LD      @-1(P3)         ;GET LOW PART OF OLD PC
0106 33              XPAL    P3
0107 CAF9            ST      PCSTK(P2)       ;UPDATE IL STACK POINTER
0109 40              LDE
010A 37              XPAH    P3              ;P3 NOW HAS OLD IL PC
010B 908E            JMP     CHEAT1
010D 9041   EOA:     JMP     E0


                  ;*************************************
                  ;*     SAVE GOSUB RETURN ADDRESS      *
                  ;*************************************

010F C2FC   SAV:     LD      SBRPTR(P2)
0111 E47A            XRI     L(DOSTAK)       ;CHECK FOR MORE
0113 981C            JZ      SAV2            ; THAN 8 SAVES
0115 AAFC            ILD     SBRPTR(P2)
0117 AAFC            ILD     SBRPTR(P2)
0119 33              XPAL    P3              ;SET P3 TO
011A C410            LDI     H(SBRSTK)       ; SUBROUTINE STACK TOP.
011C 37              XPAH    P3
011D C2F4            LD      RUNMOD(P2)      ;IF IMMEDIATE MODE,
011F 980A            JZ      SAV1            ; SAVE NEGATIVE ADDRESS.
0121 35              XPAH    P1              ;SAVE HIGH PORTION
```

```
0122 CBFF            ST      -1(P3)             ; OF CURSOR
0124 35              XPAH    P1
0125 31              XPAL    P1                 ;SAVE LOW PORTION
0126 CBFE            ST      -2(P3)             ; OF CURSOR
0128 31              XPAL    P1
0129 9001            JMP     X0                 ;RETURN
012B C4FF   SAV1     LDI     -1                 ;IMMEDIATE MODE
012D CBFF            ST      -1(P3)             ; RETURN ADDRESS IS
012F 90BB            JMP     X0                 ; NEGATIVE.
0131 C40A   SAV2:    LDI     10                 ;ERROR: MORE THAN
0133 901B            JMP     E0                 ; 8 GOSUBS


            ;************************************
            ;*     CHECK STATEMENT FINISHED     *
            ;************************************

0135 C501   DONE     LD      @1(P1)             ;SKIP SPACES
0137 E420            XRI     ' '
0139 98FA            JZ      DONE
013B E42D            XRI     ' ' ! 0D           ;IS IT CARRIAGE RETURN?
013D 9804            JZ      DONE1              ;YES - RETURN
013F E437            XRI     037                ;IS CHAR A ':' ?
0141 9C01            JNZ     DONE2              ;NO - ERROR
0143 3F     DONE1    XPPC    P3                 ;YES - RETURN
0144 C404   DONE2:   LDI     4
0146 9008            JMP     E0


            ;************************************
            ;*     RETURN FROM GOSUB            *
            ;************************************

0148 C2FC   RSTR:    LD      SBRPTR(P2)
014A E46A            XRI     L(SBRSTK)          ;CHECK FOR RETURN
014C 9C04            JNZ     RSTR1              ; W/O GOSUB.
014E C409            LDI     9
0150 9043   E0:      JMP     E1                 ;GOTO ERROR.
0152 BAFC   RSTR1:   DLD     SBRPTR(P2)
0154 BAFC            DLD     SBRPTR(P2)         ;POP GOSUB STACK,
0156 33              XPAL    P3                 ; PUT PTR INTO P3.
0157 C410            LDI     H(SBRSTK)
0159 37              XPAH    P3
015A C301            LD      1(P3)              ;IF ADDRESS NEGATIVE,
015C 9409            JP      RSTR2              ; SUBROUTINE WAS CALLED
015E C402            JS      P3,FIN             ; IN IMMEDIATE MODE,
0165 9085   X1:      JMP     X0                 ; SO FINISH UP EXECUTING
0167 35     RSTR2:   XPAH    P1                 ;RESTORE CURSOR HIGH
0168 C300            LD      0(P3)
016A 31              XPAL    P1                 ;RESTORE CURSOR LOW
016B C401            LDI     1                  ;SET RUN MODE
016D CAF4            ST      RUNMOD(P2)
016F 90F4            JMP     X1


            ;************************************
            ;*     TRANSFER TO NEW STATEMENT    *
            ;************************************

0171 C2F2   XFER:    LD      LABLHI(P2)         ;CHECK FOR NON-EXISTENT LINE
0173 9404            JP      XFER1
0175 C408            LDI     8
0177 901C            JMP     E1
0179 C401   XFER1:   LDI     1                  ;SET RUN MODE TO 1
017B CAF4            ST      RUNMOD(P2)
017D 3F              XPPC    P3


            ;************************************
            ;*     PRINT STRING IN TEXT         *
            ;************************************

017E        PRS      LDPI    P3,PUTC-1          ;POINT P3 AT PUTC ROUTINE
```

```
0184 C501            LD      @1(P1)            ;LOAD NEXT CHAR
0186 E422            XRI     '"'               ;IF ", END OF
0188 98DB            JZ      X1                ; STRING
018A E42F            XRI     02F               ;IF CR, ERROR
018C 9805            JZ      PRS1
018E E40D            XRI     0D                ;RESTORE CHAR
0190 3F              XPPC    P3                ;PRINT CHAR
0191 90EB            JMP     PRS               ;GET NEXT CHAR
0193 C407    PRS1    LDI     7                 ;SYNTAX ERROR
0195 9035    E1:     JMP     E2


                     ;************************************
                     ;*      PRINT NUMBER ON STACK        *
                     ;************************************

                     ; THIS ROUTINE IS BASED ON DENNIS ALLISON'S BINARY TO DECIMAL
                     ; CONVERSION ROUTINE IN VOL. 1, #1 OF "DR. DOBB'S JOURNAL",
                     ; BUT IS MUCH MORE OBSCURE BECAUSE OF THE STACK MANIPULATION.

                      .LOCAL
0197 C410    PRN:    LDI     H(AESTK)          ;POINT P3 AT A.E. STACK
0199 37              XPAH    P3
019A AAFD            ILD     LSTK(P2)
019C AAFD            ILD     LSTK(P2)
019E 33              XPAL    P3
019F C40A            LDI     10                ;PUT 10 ON STACK (WE'LL BE
01A1 CBFE            ST      -2(P3)            ; DIVIDING BY IT LATER)
01A3 C400            LDI     0
01A5 CBFF            ST      -1(P3)
01A7 C405            LDI     5                 ;SET CHRNUM TO POINT TO PLACE
01A9 CAE7            ST      CHRNUM(P2)        ; IN STACK WHERE WE STORE
01AB C4FF            LDI     -1                ; THE CHARACTERS TO PRINT
01AD CB05            ST      5(P3)             ;FIRST CHAR IS A FLAG (-1)
01AF C3FD            LD      -3(P3)            ;CHECK IF NUMBER IS NEGATIVE
01B1 9413            JP      $1
01B3 C42D            LDI     '-'               ;PUT '-' ON STACK, AND NEGATE
01B5 CB04            ST      4(P3)             ; THE NUMBER
01B7 C400            LDI     0
01B9 03              SCL
01BA FBFC            CAD     -4(P3)
01BC CBFC            ST      -4(P3)
01BE C400            LDI     0
01C0 FBFD            CAD     -3(P3)
01C2 CBFD            ST      -3(P3)
01C4 909F            JMP     X1                ;GO DO DIVISION BY 10
01C6 C420    $1:     LDI     ' '               ;IF POSITIVE, PUT ' ' ON
01C8 CB04            ST      4(P3)             ; STACK BEFORE DIVISION
01CA 9099    X4:     JMP     X1
01CC 9057    E2:     JMP     ERR1

                     ; THE DIVISION IS PERFORMED, THEN CONTROL IS TRANSFERRED
                     ; TO PRN1, WHICH FOLLOWS.

01CE AAFD    PRN1:   ILD     LSTK(P2)          ;POINT P1 AT A.E. STACK
01D0 AAFD            ILD     LSTK(P2)
01D2 31              XPAL    P1
01D3 C410            LDI     H(AESTK)
01D5 35              XPAH    P1
01D6 AAE7            ILD     CHRNUM(P2)        ;INCREMENT CHARACTER STACK
01D8 01              XAE                       ; POINTER, PUT IN EX. REG.
01D9 C101            LD      1(P1)             ;GET REMAINDER FROM DIVIDE,
01DB DC30            ORI     '0'
01DD C980            ST      EREG(P1)          ; PUT IT ON THE STACK
01DF C1FD            LD      -3(P1)            ;IS THE QUOTIENT ZERO YET?
01E1 D9FC            OR      -4(P1)
01E3 980A            JZ      $PRNT             ;YES - GO PRINT THE NUMBER
01E5 C40F            LDI     H(PRNUM1)         ;NO - CHANGE THE I.L. PC
01E7 CAFA            ST      PCHIGH(P2)        ; SO THAT DIVIDE IS
01E9 C42F            LDI     L(PRNUM1)         ; PERFORMED AGAIN
01EB CAFB            ST      PCLOW(P2)
01ED 90DB            JMP     X4                ;GO DO DIVISION BY 10 AGAIN
01EF         $PRNT:  LDPI    P3,PUTC-1         ;POINT P3 AT PUTC ROUTINE
01F5 C2F5            LD      LISTNG(P2)        ;IF LISTING, SKIP PRINTING
```

```
01F7 9C06                JNZ     $2              ; LEADING SPACE
01F9 C104                LD      4(P1)           ;PRINT EITHER '-'
01FB 3F                  XPPC    P3              ; OR LEADING SPACE
01FC C2E7                LD      CHRNUM(P2)      ;GET EX. REG. VALUE BACK
01FE 01                  XAE
01FF C580      $2:       LD      @EREG(P1)       ;POINT P3 AT FIRST CHAR
0201 C100                LD      (P1)            ; TO BE PRINTED
0203 3F        $LOOP:    XPPC    P3              ;PRINT THE CHARACTER
0204 C5FF                LD      @-1(P1)         ;GET NEXT CHARACTER
0206 94FB                JP      $LOOP           ;REPEAT UNTIL = -1
0208 C450                LDI     L(AESTK)
020A CAFD                ST      LSTK(P2)        ;CLEAR THE A.E. STACK
020C C2F5                LD      LISTNG(P2)      ;PRINT A TRAILING SPACE
020E 9CBA                JNZ     X4              ; IF NOT LISTING PROGRAM
0210 C420                LDI     ' '
0212 3F                  XPPC    P3
0213 90B5                JMP     X4


               ;************************************
               ;*     CARRIAGE RETURN/LINE FEED    *
               ;************************************

0215           NLINE:    LDPI    P3,PUTC-1       ;POINT P3 AT PUTC ROUTINE
021B C40D                LDI     0D              ;CARRIAGE RETURN
021D 3F                  XPPC    P3
021E C40A                LDI     0A              ;LINE FEED
0220 3F                  XPPC    P3
0221 90A7      X5:       JMP     X4


               ;************************************
               ;*     ERROR  ROUTINE               *
               ;************************************

                         .LOCAL
0223 C405      ERR:      LDI     5               ;SYNTAX ERROR
0225 CAEB      ERR1:     ST      NUM(P2)         ;SAVE ERROR #
0227 C2EB      ERR2:     LD      NUM(P2)
0229 CAEA                ST      TEMP(P2)
022B                     LDPI    P3,PUTC-1       ;POINT P3 AT PUTC
0231 C40D                LDI     0D              ;PRINT CR/LF
0233 3F                  XPPC    P3
0234 C40A                LDI     0A
0236 3F                  XPPC    P3
0237                     LDPI    P1,MESGS        ;P1 -> ERROR MESSAGES
023D BAEB      $1:       DLD     NUM(P2)         ;IS THIS THE RIGHT MESSAGE?
023F 9806                JZ      $MSG            ;YES - GO PRINT IT
0241 C501      $LOOP:    LD      @1(P1)          ;NO - SCAN THROUGH TO
0243 94FC                JP      $LOOP           ; NEXT MESSAGE
0245 90F6                JMP     $1
0247 C501      $MSG:     LD      @1(P1)          ;GET MESSAGE CHAR
0249 3F                  XPPC    P3              ;PRINT IT
024A C1FF                LD      -1(P1)          ;IS MESSAGE DONE?
024C 94F9                JP      $MSG            ;NO - GET NEXT CHAR
024E C2EA                LD      TEMP(P2)        ;WAS THIS A BREAK MESSAGE?
0250 E40E                XRI     14
0252 980D                JZ      $3              ;YES - SKIP PRINTING 'ERROR'
0254                     LDPI    P1,MESGS        ;NO - PRINT 'ERROR'
025A C501      $2:       LD      @1(P1)          ;GET CHARACTER
025C 3F                  XPPC    P3              ;PRINT IT
025D C1FF                LD      -1(P1)          ;DONE?
025F 94F9                JP      $2              ;NO - REPEAT LOOP
0261 C2F4      $3:       LD      RUNMOD(P2)      ;DON'T PRINT LINE #
0263 984D                JZ      FIN             ; IF IMMEDIATE MODE
0265 C420                LDI     ' '
0267 3F                  XPPC    P3              ;SPACE
0268 C441                LDI     'A'             ;AT
026A 3F                  XPPC    P3
026B C454                LDI     'T'
026D 3F                  XPPC    P3
026E C410                LDI     H(AESTK)        ;POINT P3 AT A.E. STACK
0270 37                  XPAH    P3
```

```
0271 AAFD          ILD     LSTK(P2)
0273 AAFD          ILD     LSTK(P2)
0275 33            XPAL    P3
0276 C2F7          LD      HILINE(P2)        ;GET HIGH BYTE OF LINE #
0278 CBFF          ST      -1(P3)            ;PUT ON STACK
027A C2F8          LD      LOLINE(P2)        ;GET LOW BYTE OF LINE #
027C CBFE          ST      -2(P3)            ;PUT ON STACK
027E C42D          LDI     L(ERRNUM)         ;GO TO PRN
0280 CAFB          ST      PCLOW(P2)
0282 C40E          LDI     H(ERRNUM)
0284 CAFA          ST      PCHIGH(P2)
0286 9099   X5A:   JMP     X5


            ;*************************************
            ;*     BREAK, NXT, FIN, & STRT      *
            ;*************************************

0288 C40E   BREAK: LDI     14
028A 9099   E3A:   JMP     ERR1
                                             ;*** NEXT STATEMENT ***
028C C2F4   NXT:   LD      RUNMOD(P2)        ;IF IN IMMED. MODE,
028E 9822          JZ      FIN               ; STOP EXECUTION
0290 C100          LD      (P1)              ;IF WE HIT END OF FILE,
0292 D480          ANI     080               ; FINISH UP THINGS
0294 9C1C          JNZ     FIN
0296 06            CSA                       ;BREAK IF SOMEONE IS
0297 D420          ANI     020               ; TYPING ON THE CONSOLE
0299 98ED          JZ      BREAK
029B C1FF          LD      -1(P1)            ;GET LAST CHARACTER SCANNED
029D E40D          XRI     0D                ;WAS IT CARRIAGE RETURN?
029F 9C08          JNZ     NXT1              ;YES - SKIP FOLLOWING UPDATES
02A1 C501          LD      @1(P1)            ;GET HIGH BYTE OF NEXT LINE #
02A3 CAF7          ST      HILINE(P2)        ;SAVE IT
02A5 C502          LD      @2(P1)            ;GET LOW BYTE OF LINE #, SKIP
02A7 CAF8          ST      LOLINE(P2)        ; LINE LENGTH BYTE
02A9 C40C   NXT1:  LDI     H(STMT)           ;GO TO 'STMT' IN IL TABLE
02AB CAFA          ST      PCHIGH(P2)
02AD C482          LDI     L(STMT)
02AF CAFB          ST      PCLOW(P2)
02B1 3F            XPPC    P3

02B2 C400   FIN:   LDI     0                 ;*** FINISH EXECUTION ***
02B4 CAF4          ST      RUNMOD(P2)        ;CLEAR RUN MODE
02B6 C450          LDI     L(AESTK)          ;CLEAR ARITHMETIC STACK
02B8 CAFD          ST      LSTK(P2)
02BA C418          LDI     L(START)          ;SET IL PC TO GETTING LINES
02BC CAFB          ST      PCLOW(P2)
02BE C40C          LDI     H(START)
02C0 CAFA          ST      PCHIGH(P2)
02C2 C4A6          LDI     L(PCSTAK)
02C4 CAF9          ST      PCSTK(P2)
02C6 90BE          JMP     X5A
                                             ;*** START EXECUTION ***
02C8 AAF4   STRT:  ILD     RUNMOD(P2)        ;RUN MODE = 1
02CA C2E9          LD      TEMP2(P2)         ;POINT CURSOR TO
02CC 35            XPAH    P1                ; START OF NIBL PROGRAM
02CD C2E8          LD      TEMP3(P2)
02CF 31            XPAL    P1
02D0 C46A          LDI     L(SBRSTK)         ;EMPTY SOME STACKS:
02D2 CAFC          ST      SBRPTR(P2)        ; GOSUB STACK,
02D4 C48A          LDI     L(FORSTK)
02D6 CAFE          ST      FORPTR(P2)        ; FOR STACK
02D8 C47A          LDI     L(DOSTAK)
02DA CAFF          ST      DOPTR(P2)         ; & DO/UNTIL STACK
02DC 3F            XPPC    P3                ;RETURN
02DD 90A7   X6:    JMP     X5A
02DF 90A9   E4:    JMP     E3A


            ;*************************************
            ;*       LIST NIBL PROGRAM          *
            ;*************************************
```

```

02E1 C100    LST     LD      (P1)            ;CHECK FOR END OF FILE
02E3 E480            XRI     080
02E5 9418            JP      LST2
02E7 C410            LDI     H(AESTK)        ;GET LINE NUMBER ONTO STACK
02E9 37              XPAH    P3
02EA AAFD            ILD     LSTK(P2)
02EC AAFD            ILD     LSTK(P2)
02EE 33              XPAL    P3
02EF C501            LD      @1(P1)
02F1 CBFF            ST      -1(P3)
02F3 C501            LD      @1(P1)
02F5 CBFE            ST      -2(P3)
02F7 C501            LD      @1(P1)          ;SKIP OVER LINE LENGTH
02F9 C401            LDI     1
02FB CAF5            ST      LISTNG(P2)      ;SET LISTING FLAG
02FD 90DE            JMP     X6              ;GO PRINT LINE NUMBER
02FF C400    LST2    LDI     0
0301 CAF5            ST      LISTNG(P2)      ;CLEAR LISTING FLAG
0303 C402            JS      P3,NXT          ;GO TO NXT
030A 90D1    X6A:    JMP     X6
030C 90D1    E5:     JMP     E4
030E         LST3    LDPI    P3,PUTC-1       ;POINT P3 AT PUTC
0314 06      LST4:   CSA
0315 D420            ANI     020
0317 98E6            JZ      LST2            ;IF TYPING, STOP
0319 C501            LD      @1(P1)          ;GET NEXT CHAR
031B E40D            XRI     0D              ;TEST FOR CR
031D 9805            JZ      LST5

031F E40D            XRI     0D              ;GET CHARACTER
0321 3F              XPPC    P3              ;PRINT CHARACTER
0322 90F0            JMP     LST4
0324 C40D    LST5    LDI     0D              ;CARRIAGE RETURN
0326 3F              XPPC    P3
0327 C40A            LDI     0A              ;LINE FEED
0329 3F              XPPC    P3
032A 02              CCL
032B C447            LDI     L(LIST3)
032D CAFB            ST      PCLOW(P2)
032F C40C            LDI     H(LIST3)
0331 CAFA            ST      PCHIGH(P2)
0333 90AC            JMP     LST             ;GET NEXT LINE


             ;*************************************
             ;*           ADD AND SUBTRACT        *
             ;*************************************

0335 C410    ADD     LDI     H(AESTK)        ;SET P3 TO CURRENT
0337 37              XPAH    P3              ; STACK LOCATION
0338 BAFD            DLD     LSTK(P2)
033A BAFD            DLD     LSTK(P2)
033C 33              XPAL    P3
033D 02              CCL
033E C3FE            LD      -2(P3)          ;REPLACE TWO TOP ITEMS
0340 F300            ADD     0(P3)           ; ON STACK BY THEIR SUM
0342 CBFE            ST      -2(P3)
0344 C3FF            LD      -1(P3)
0346 F301            ADD     1(P3)
0348 CBFF            ST      -1(P3)
034A 90BE    X7:     JMP     X6A

034C C410    SUB     LDI     H(AESTK)        ;SET P3 TO CURRENT
034E 37              XPAH    P3              ; STACK LOCATION
034F BAFD            DLD     LSTK(P2)
0351 BAFD            DLD     LSTK(P2)
0353 33              XPAL    P3
0354 03              SCL
0355 C3FE            LD      -2(P3)          ;REPLACE TWO TOP ITEMS
0357 FB00            CAD     0(P3)           ; ON STACK BY THEIR DIFFERENC
0359 CBFE            ST      -2(P3)
035B C3FF            LD      -1(P3)
035D FB01            CAD     1(P3)
```

```
035F CBFF          ST     -1(P3)
0361 90A7          JMP    X6A


                ************************************
               ;*          NEGATE                  *
               ;************************************

0363 C410    NEG:  LDI    H(AESTK)        ;SET P3 TO CURRENT
0365 37            XPAH   P3              ; STACK LOCATION
0366 C2FD          LD     LSTK(P2)
0368 33            XPAL   P3
0369 03            SCL
036A C400          LDI    0
036C FBFE          CAD    -2(P3)          ;NEGATE TOP ITEM ON STACK
036E CBFE          ST     -2(P3)
0370 C400          LDI    0
0372 FBFF          CAD    -1(P3)
0374 CBFF          ST     -1(P3)
0376 90D2    X8:   JMP    X7
0378 9092    E6:   JMP    E5



               ;************************************
               ;*        MULTIPLY                  *
               ;************************************

                    LOCAL
037A C410    MUL:  LDI    H(AESTK)        ;SET P3 TO CURRENT
037C 37            XPAH   P3              ; STACK LOCATION
037D C2FD          LD     LSTK(P2)
037F 33            XPAL   P3              ;DETERMINE SIGN OF PRODUCT,
0380 C3FF          LD     -1(P3)          ; SAVE IN TEMP(P2)
0382 E3FD          XOR    -3(P3)
0384 CAEA          ST     TEMP(P2)
0386 C3FF          LD     -1(P3)          ;CHECK FOR NEGATIVE
0388 940D          JP     $1              ; MULTIPLIER
038A 03            SCL
038B C400          LDI    0               ;IF NEGATIVE,
038D FBFE          CAD    -2(P3)          ; NEGATE
038F CBFE          ST     -2(P3)
0391 C400          LDI    0
0393 FBFF          CAD    -1(P3)
0395 CBFF          ST     -1(P3)
0397 C3FD    $1:   LD     -3(P3)          ;CHECK FOR NEGATIVE
0399 940D          JP     $2              ; MULTIPLICAND
039B 03            SCL
039C C400          LDI    0               ;IF NEGATIVE,
039E FBFC          CAD    -4(P3)          ; NEGATE
03A0 CBFC          ST     -4(P3)
03A2 C400          LDI    0
03A4 FBFD          CAD    -3(P3)
03A6 CBFD          ST     -3(P3)
03A8 C400    $2:   LDI    0               ;CLEAR WORKSPACE
03AA CB00          ST     0(P3)
03AC CB01          ST     1(P3)
03AE CB02          ST     2(P3)
03B0 CB03          ST     3(P3)
03B2 C410          LDI    16              ;SET COUNTER TO 16
03B4 CAEB          ST     NUM(P2)
03B6 C3FF    $LOOP: LD    -1(P3)          ;ROTATE MULTIPLIER
03B8 1F            RRL                    ; RIGHT ONE BIT
03B9 CBFF          ST     -1(P3)
03BB C3FE          LD     -2(P3)
03BD 1F            RRL
03BE CBFE          ST     -2(P3)
03C0 06            CSA                    ;CHECK FOR CARRY BIT
03C1 9411          JP     $3              ;IF NOT SET, DON'T DO ADD
03C3 02            CCL
03C4 C302          LD     2(P3)           ;ADD MULTIPLICAND
03C6 F3FC          ADD    -4(P3)          ; INTO WORKSPACE
03C8 CB02          ST     2(P3)
```

```
03CA  C303          LD      3(P3)
03CC  F3FD          ADD     -3(P3)
03CE  CB03          ST      3(P3)
03D0  9007          JMP     $3
03D2  90A4  E6A     JMP     E6
03D4  02    $3      CCL
03D5  C303          LD      3(P3)           ;SHIFT WORKSPACE RIGHT BY 1
03D7  1F            RRL
03D8  CB03          ST      3(P3)
03DA  C302          LD      2(P3)
03DC  1F            RRL
03DD  CB02          ST      2(P3)
03DF  C301          LD      1(P3)
03E1  1F            RRL
03E2  CB01          ST      1(P3)
03E4  C300          LD      0(P3)
03E6  1F            RRL
03E7  CB00          ST      0(P3)
03E9  BAEB          DLD     NUM(P2)         ;DECREMENT COUNTER
03EB  9C09          JNZ     $LOOP           ;LOOP IF NOT ZERO
03ED  9002          JMP     $4
03EF  9085  X9      JMP     X8
03F1  C2EA  $4      LD      TEMP(P2)        ;CHECK SIGN WORD
03F3  940D          JP      $EXIT           ;IF BIT7 = 1, NEGATE PRODUCT
03F5  03            SCL
03F6  C400          LDI     0
03F8  FB00          CAD     0(P3)
03FA  CB00          ST      0(P3)
03FC  C400          LDI     0
03FE  FB01          CAD     1(P3)
0400  CB01          ST      1(P3)
0402  C300  $EXIT   LD      0(P3)           ;PUT PRODUCT ON TOP
0404  CBFC          ST      -4(P3)          ; OF STACK
0406  C301          LD      1(P3)
0408  CBFD          ST      -3(P3)
040A  BAFD          DLD     LSTK(P2)        ;SUBTRACT 2 FROM
040C  BAFD          DLD     LSTK(P2)        ; LSTK
040E  90DF          JMP     X9


            ;**************************************
            ;*            DIVIDE                  *
            ;**************************************

                    .LOCAL
0410  C410  DIV     LDI     H(AESTK)
0412  37            XPAH    P3
0413  C2FD          LD      LSTK(P2)
0415  33            XPAL    P3
0416  C3FF          LD      -1(P3)          ;CHECK FOR DIVISION BY 0
0418  DBFE          OR      -2(P3)
041A  9C04          JNZ     $0
041C  C40D          LDI     13
041E  90B2          JMP     E6A
0420  C3FD  $0      LD      -3(P3)
0422  E3FF          XOR     -1(P3)
0424  CAEA          ST      TEMP(P2)        ;SAVE SIGN OF QUOTIENT
0426  C3FD          LD      -3(P3)          ;IS DIVIDEND POSITIVE?
0428  9411          JP      $POS            ;YES - JUMP
042A  C400          LDI     0
042C  03            SCL
042D  FBFC          CAD     -4(P3)          ;NO - NEGATE DIVIDEND,
042F  CB03          ST      3(P3)           ; STORE IN RIGHT HALF
0431  C400          LDI     0               ; OF 32-BIT ACCUMULATOR
0433  FBFD          CAD     -3(P3)
0435  CB02          ST      2(P3)
0437  900A          JMP     $1
0439  90B4  X9A     JMP     X9
043B  C3FD  $POS    LD      -3(P3)          ;STORE NON-NEGATED DIVIDEND
043D  CB02          ST      2(P3)           ; IN 32-BIT ACCUMULATOR
043F  C3FC          LD      -4(P3)
0441  CB03          ST      3(P3)
0443  C3FF  $1      LD      -1(P3)          ;CHECK FOR NEGATIVE DIVISOR
```

```
0445 940D          JP     $2
0447 C400          LDI    0                  ;NEGATE DIVISOR
0449 03            SCL
044A FBFE          CAD    -2(P3)
044C CBFE          ST     -2(P3)
044E C400          LDI    0
0450 FBFF          CAD    -1(P3)
0452 CBFF          ST     -1(P3)
0454 C400  $2:     LDI    0                  ;PUT ZERO IN:
0456 CB01          ST     1(P3)              ;  LEFT HALF OF 32-BIT ACC,
0458 CB00          ST     0(P3)
045A CAEB          ST     NUM(P2)            ;  THE COUNTER, AND
045C CBFD          ST     -3(P3)             ;  IN THE DIVIDEND, NOW USED
045E CBFC          ST     -4(P3)             ;  STORE THE QUOTIENT
0460 02    $LOOP:  CCL                       ;BEGIN MAIN DIVIDE LOOP:
0461 C3FC          LD     -4(P3)             ;  SHIFT QUOTIENT LEFT,
0463 F3FC          ADD    -4(P3)
0465 CBFC          ST     -4(P3)
0467 C3FD          LD     -3(P3)
0469 F3FD          ADD    -3(P3)
046B CBFD          ST     -3(P3)
046D 02            CCL                       ;  SHIFT 32-BIT ACC LEFT,
046E C303          LD     3(P3)
0470 F303          ADD    3(P3)
0472 CB03          ST     3(P3)
0474 C302          LD     2(P3)
0476 F302          ADD    2(P3)
0478 CB02          ST     2(P3)
047A C301          LD     1(P3)
047C F301          ADD    1(P3)
047E CB01          ST     1(P3)
0480 C300          LD     (P3)
0482 F300          ADD    (P3)
0484 CB00          ST     (P3)
0486 03            SCL
0487 C301          LD     1(P3)              ;  SUBTRACT DIVISOR INTO
0489 FBFE          CAD    -2(P3)             ;   LEFT HALF OF ACC,
048B CB01          ST     1(P3)
048D C300          LD     (P3)
048F FBFF          CAD    -1(P3)
0491 CB00          ST     (P3)
0493 9411          JP     $ENT1              ;  IF RESULT IS NEGATIVE,
0495 02            CCL                       ;   RESTORE ORIGINAL CONTENTS
0496 C301          LD     1(P3)              ;   OF ACC BY ADDING DIVISOR
0498 F3FE          ADD    -2(P3)
049A CB01          ST     1(P3)
049C C300          LD     (P3)
049E F3FF          ADD    -1(P3)
04A0 CB00          ST     (P3)
04A2 9008          JMP    $3
04A4 9093  X9B:    JMP    X9A
04A6 C3FC  $ENT1   LD     -4(P3)             ;  ELSE IF RESULT POSITIVE,
04A8 DC01          ORI    1                  ;   RECORD A 1 IN QUOTIENT
04AA CBFC          ST     -4(P3)             ;   W/O RESTORING THE ACC
04AC AAEB  $3      ILD    NUM(P2)            ;  INCREMENT THE COUNTER
04AE E410          XRI    16                 ;  ARE WE DONE?
04B0 9CAE          JNZ    $LOOP              ;  LOOP IF NOT DONE
04B2 C2EA          LD     TEMP(P2)           ;CHECK THE QUOTIENT'S SIGN,
04B4 940D          JP     $END               ; NEGATING IF, NECESSARY
04B6 C400          LDI    0
04B8 03            SCL
04B9 FBFC          CAD    -4(P3)
04BB CBFC          ST     -4(P3)
04BD C400          LDI    0
04BF FBFD          CAD    -3(P3)
04C1 CBFD          ST     -3(P3)
04C3 BAFD  $END:   DLD    LSTK(P2)           ;DECREMENT THE STACK POINTER,
04C5 BAFD          DLD    LSTK(P2)
04C7 90DB          JMP    X9B                ; AND EXIT


           ;************************************
           ;*         STORE VARIABLE           *
           ;************************************
```

```

0409 C410  STORE    LDI       H(AESTK)            ;SET P3 TO STACK
04CB 37             XPAH      P3
04CC C2FD           LD        LSTK(P2)
04CE 33             XPAL      P3
04CF C7FD           LD        @-3(P3)             ;GET VARIABLE INDEX
04D1 01             XAE                           ;PUT IN E REG
04D2 C301           LD        1(P3)
04D4 CA80           ST        EREG(P2)            ;STORE LOWER 8 BITS
04D6 02             CCL                           ; INTO VARIABLE
04D7 40             LDE                           ;INCREMENT INDEX
04D8 F401           ADI       1
04DA 01             XAE
04DB C302           LD        2(P3)
04DD CA80           ST        EREG(P2)            ;STORE UPPER 8 BITS
04DF 33             XPAL      P3                  ; INTO VARIABLE
04E0 CAFD           ST        LSTK(P2)            ;UPDATE STACK POINTER
04E2 C400  X10:     JS        P3,EXECIL


           ;*************************************
           ;*     TEST FOR VARIABLE IN TEXT     *
           ;*************************************

04E9 C501  TSTVAR:  LD        @1(P1)
04EB E420           XRI       ' '                 ;SLEW OFF SPACES
04ED 98FA           JZ        TSTVAR
04EF C1FF           LD        -1(P1)              ;GET CHARACTER IN QUESTION
04F1 03             SCL
04F2 FC5B           CAI       'Z'+1               ;SUBTRACT 'Z'+1
04F4 9405           JP        $FAIL               ;NOT VARIABLE IF POSITIVE
04F6 03             SCL
04F7 FCE6           CAI       'A'-'Z'-1           ;SUBTRACT 'A'
04F9 9412           JP        $MAYBE              ;IF POS, MAY BE VARIABLE
04FB C5FF  $FAIL:   LD        @-1(P1)             ;BACKSPACE CURSOR
04FD C2FB           LD        PCLOW(P2)           ;GET TEST-FAIL ADDRESS
04FF 33             XPAL      P3                  ; FROM I.L. TABLE, PUT IT
0500 C2FA           LD        PCHIGH(P2)          ; INTO I.L. PROGRAM COUNTER
0502 37             XPAH      P3
0503 C300           LD        (P3)
0505 CAFA           ST        PCHIGH(P2)
0507 C301           LD        1(P3)
0509 CAFB           ST        PCLOW(P2)
050B 90D5           JMP       X10
050D 01    $MAYBE:  XAE                           ;SAVE VALUE (0-25)
050E C100           LD        (P1)                ;CHECK FOLLOWING CHAR
0510 03             SCL                           ;MUST NOT BE A LETTER
0511 FC5B           CAI       'Z'+1               ; OTHERWISE WE'D BE LOOKING
0513 9405           JP        $OK                 ; AT A KEYWORD, NOT VARIABLE
0515 03             SCL
0516 FCE6           CAI       'A'-'Z'-1
0518 94E1           JP        $FAIL
051A C410  $OK:     LDI       H(AESTK)            ;SET P3 TO CURRENT
051C 37             XPAH      P3                  ; STACK LOCATION
051D AAFD           ILD       LSTK(P2)            ;INCR STACK POINTER
051F 33             XPAL      P3
0520 02             CCL                           ;DOUBLE VARIABLE INDEX
0521 40             LDE
0522 70             ADE
0523 CBFF           ST        -1(P3)              ;PUT INDEX ON STACK
0525 C402           LDI       2                   ;INCREMENT I.L. PC, SKIPPING
0527 02             CCL                           ; OVER TEST-FAIL ADDRESS
0528 F2FB           ADD       PCLOW(P2)
052A CAFB           ST        PCLOW(P2)
052C C400           LDI       0
052E F2FA           ADD       PCHIGH(P2)
0530 CAFA           ST        PCHIGH(P2)
0532 90AE           JMP       X10


           ;*************************************
           ;*     IND -- EVALUATE A VARIABLE    *
           ;*************************************

```

```
0534 C410   IND:     LDI     H(AESTK)         ;SET P3 TO STACK
0536 37              XPAH    P3
0537 AAFD            ILD     LSTK(P2)
0539 33              XPAL    P3
053A C3FE            LD      -2(P3)           ;GET INDEX OFF TOP
053C 01              XAE                      ;PUT INDEX IN E REG
053D C280            LD      EREG(P2)         ;GET LOWER 8 BITS
053F CBFE            ST      -2(P3)           ;SAVE ON STACK
0541 02              CCL
0542 40              LDE                      ;INCREMENT E REG
0543 F401            ADI     1
0545 01              XAE
0546 C280            LD      EREG(P2)         ;GET UPPER 8 BITS
0548 CBFF            ST      -1(P3)           ;SAVE ON STACK
054A 9096   X11:     JMP     X10


                     ;**********************************
                     ;*      RELATIONAL OPERATORS       *
                     ;**********************************

054C C401   EQ:      LDI     1                ;EACH RELATIONAL OPERATOR
054E 9012            JMP     CMP              ; LOADS A NUMBER USED LATER
0550 C402   NEQ:     LDI     2                ; AS A CASE SELECTOR, AFTER
0552 900E            JMP     CMP              ; THE TWO OPERANDS ARE COM-
0554 C403   LSS:     LDI     3                ; PARED. BASED ON THE COM-
0556 900A            JMP     CMP              ; PARISON, FLAGS ARE SET THAT
0558 C404   LEQ:     LDI     4                ; ARE EQUIVALENT TO THOSE SET
055A 9006            JMP     CMP              ; BY THE 'CMP' INSTRUCTION IN
055C C405   GTR:     LDI     5                ; THE PDP-11. THESE PSEUDO-
055E 9002            JMP     CMP              ; FLAGS ARE USED TO DETERMINE
0560 C406   GEQ:     LDI     6                ; WHETHER THE PARTICULAR
                                              ; RELATION IS SATISFIED OR NO
0562 CAEB   CMP:     ST      NUM(P2)
0564 C410            LDI     H(AESTK)         ;SET P3 -> ARITH STACK
0566 37              XPAH    P3
0567 BAFD            DLD     LSTK(P2)
0569 BAFD            DLD     LSTK(P2)
056B 33              XPAL    P3
056C 03              SCL
056D C3FE            LD      -2(P3)           ;SUBTRACT THE TWO OPERANDS,
056F FB00            CAD     (P3)             ; STORING RESULT IN LO & HI
0571 CAEF            ST      LO(P2)
0573 C3FF            LD      -1(P3)
0575 FB01            CAD     1(P3)
0577 CAEE            ST      HI(P2)
0579 E3FF            XOR     -1(P3)           ;OVERFLOW OCCURS IF SIGNS OF
057B 01              XAE                      ; RESULT AND 1ST OPERAND
057C C3FF            LD      -1(P3)           ; DIFFER, AND SIGNS OF THE
057E E301            XOR     1(P3)            ; TWO OPERANDS DIFFER
0580 50              ANE                      ;BIT 7 EQUIVALENT TO V FLAG
0581 E2EE            XOR     HI(P2)           ;BIT 7 EQUIVALENT TO N XOR V
0583 CAEA            ST      TEMP(P2)         ;STORE IN TEMP
0585 C2EE            LD      HI(P2)           ;DETERMINE IF RESULT WAS ZERO
0587 DAEF            OR      LO(P2)
0589 9802            JZ      SETZ             ;IF RESULT=0, SET Z FLAG
058B C480            LDI     080              ; ELSE CLEAR Z FLAG
058D E480   SETZ:    XRI     080
058F 01              XAE                      ;BIT 7 OF EX = Z FLAG

0590 BAEB            DLD     NUM(P2)          ;TEST FOR =
0592 9C05            JNZ     NEQ1
0594 40              LDE                      ; EQUAL IF Z = 1
0595 902B            JMP     CMP1
0597 90B1   X12:     JMP     X11
0599 BAEB   NEQ1:    DLD     NUM(P2)          ;TEST FOR <>
059B 9C05            JNZ     LSS1
059D 40              LDE                      ; NOT EQUAL IF Z = 0
059E E480            XRI     080
05A0 9020            JMP     CMP1
05A2 BAEB   LSS1:    DLD     NUM(P2)          ;TEST FOR <
05A4 9C04            JNZ     LEQ1
05A6 C2EA            LD      TEMP(P2)         ; LESS THAN IF (N XOR V)=1
```

```
1005 05A8 9018            JMP     CMP1
1006 05AA BAEB   LEQ1     DLD     NUM(P2)         ;TEST FOR <=
1007 05AC 9005            JNZ     GTR1
1008 05AE 40              LDE                     ; LESS THAN OR EQUAL
1009 05AF DAEA            OR      TEMP(P2)        ;   IF (Z OR (N XOR V))=1
1010 05B1 900F            JMP     CMP1
1011 05B3 BAEB   GTR1:    DLD     NUM(P2)         ;TEST FOR >
1012 05B5 9007            JNZ     GEQ1
1013 05B7 40              LDE                     ; GREATER THAN
1014 05B8 DAEA            OR      TEMP(P2)        ;   IF (Z OR (N XOR V))=0
1015 05BA E480            XRI     080
1016 05BC 9004            JMP     CMP1
1017 05BE C2EA   GEQ1:    LD      TEMP(P2)        ;GREATER THAN OR EQUAL
1018 05C0 E480            XRI     080             ;  IF (N XOR V)=0
1019 05C2 9404   CMP1:    JP      FALSE           ;IS RELATION SATISFIED?
1020 05C4 C401            LDI     1               ;YES - PUSH 1 ON STACK
1021 05C6 9002            JMP     CMP2
1022 05C8 C400   FALSE:   LDI     0               ;NO - PUSH 0 ON STACK
1023 05CA CBFE   CMP2:    ST      -2(P3)
1024 05CC C400            LDI     0
1025 05CE CBFF            ST      -1(P3)
1026 05D0 C400            JS      P3,RTN          ;DO AN I.L. RETURN
1027 05D7 90BE            JMP     X12
1028
1029
1030             ;************************************
1031             ;*    IF STATEMENT TEST FOR ZERO      *
1032             ;************************************
1033
1034 05D9 C2EF   CMPR:    LD      LO(P2)          ;GET LOW & HI BYTES OF EXPR.
1035 05DB DAEE            OR      HI(P2)          ;TEST IF EXPRESSION IS ZERO
1036 05DD 9802            JZ      FAIL            ;YES - IT IS
1037 05DF 90B6            JMP     X12             ;NO - IT ISN'T SO CONTINUE
1038 05E1 C501   FAIL:    LD      @1(P1)          ;SKIP TO NEXT LINE IN PROGRAM
1039 05E3 E40D            XRI     0D              ;  (I.E. TIL NEXT CR)
1040 05E5 90FA            JNZ     FAIL
1041 05E7 C402            JS      P3,NXT          ;CALL NXT AND RETURN
1042 05EE 90A7   X12A:    JMP     X12
1043
1044
1045             ;************************************
1046             ;*         AND, OR, & NOT           *
1047             ;************************************
1048
1049                      .LOCAL
1050 05F0 C401   ANDOP:   LDI     1               ;EACH OPERATION HAS ITS
1051 05F2 9006            JMP     $1              ;  OWN CASE SELECTOR.
1052 05F4 C402   OROP:    LDI     2
1053 05F6 9002            JMP     $1
1054 05F8 C403   NOTOP:   LDI     3
1055 05FA CAEB   $1:      ST      NUM(P2)
1056 05FC C410            LDI     H(AESTK)        ;SET P3 -> ARITH. STACK
1057 05FE 37              XPAH    P3
1058 05FF BAFD            DLD     LSTK(P2)
1059 0601 BAFD            DLD     LSTK(P2)
1060 0603 33              XPAL    P3
1061 0604 BAEB            DLD     NUM(P2)         ;TEST FOR 'AND'
1062 0606 9C0E            JNZ     $OR
1063 0608 C301            LD      1(P3)           ;REPLACE TWO TOP ITEMS ON
1064 060A D3FF            AND     -1(P3)          ;  STACK BY THEIR 'AND'
1065 060C CBFF            ST      -1(P3)
1066 060E C300            LD      0(P3)
1067 0610 D3FE            AND     -2(P3)
1068 0612 CBFE            ST      -2(P3)
1069 0614 90D8            JMP     X12A
1070 0616 BAEB   $OR:     DLD     NUM(P2)         ;TEST FOR 'OR'
1071 0618 9C0E            JNZ     $NOT
1072 061A C301            LD      1(P3)           ;REPLACE TWO TOP ITEMS ON
1073 061C DBFF            OR      -1(P3)          ;  STACK BY THEIR 'OR'
1074 061E CBFF            ST      -1(P3)
1075 0620 C300            LD      0(P3)
1076 0622 DBFE            OR      -2(P3)
1077 0624 CBFE            ST      -2(P3)
```

```
0626 90C6           JMP     X12A
0628 C701   $NOT    LD      @1(P3)         ;´NOT´ OPERATION
062A E4FF           XRI     OFF
062C CBFF           ST      -1(P3)         ;REPLACE TOP ITEM ON STACK
062E C701           LD      @1(P3)         ; BY ITS ONE´S COMPLEMENT
0630 E4FF           XRI     OFF
0632 CBFF           ST      -1(P3)
0634 33             XPAL    P3
0635 CAFD           ST      LSTK(P2)       ;STACK POINTER FIXUP
0637 90B5   X12B:   JMP     X12A


            ;*************************************
            ;*     EXCHANGE CURSOR WITH RAM     *
            ;*************************************

0639 C2F1   XCHGP1: LD      P1LOW(P2)      ;THIS ROUTINE IS HANDY WHEN
063B 31             XPAL    P1             ; EXECUTING AN ´INPUT´ STMT
063C CAF1           ST      P1LOW(P2)      ; IT EXCHANGES THE CURRENT
063E C2F0           LD      P1HIGH(P2)     ; TEXT CURSOR WITH ONE SAVED
0640 35             XPAH    P1             ; IN RAM
0641 CAF0           ST      P1HIGH(P2)
0643 3F             XPPC    P3


            ;*************************************
            ;*         CHECK RUN MODE           *
            ;*************************************

0644 C2F4   CKMODE: LD      RUNMOD(P2)     ;THIS ROUTINE CAUSES AN ERROR
0646 9801           JZ      CK1            ; IF CURRENTLY IN EDIT MODE
0648 3F             XPPC    P3
0649 C403   CK1:    LDI     3
064B CAEB   E8:     ST      NUM(P2)        ;ERROR IF RUN MODE = 0
064D C402           JS      P3,ERR2        ;MINOR KLUGE


            ;*************************************
            ;*      GET HEXADECIMAL NUMBER      *
            ;*************************************

                     LOCAL
0654 AAFD   HEX:    ILD     LSTK(P2)       ;POINT P3 AT ARITH STACK
0656 AAFD           ILD     LSTK(P2)
0658 33             XPAL    P3
0659 C410           LDI     H(AESTK)
065B 37             XPAH    P3
065C C400           LDI     0              ;NUMBER INITIALLY ZERO
065E CBFF           ST      -1(P3)         ;PUT IT ON STACK
0660 CBFE           ST      -2(P3)
0662 CAEB           ST      NUM(P2)        ;ZERO NUMBER OF DIGITS
0664 C501   $SKIP:  LD      @1(P1)         ;SKIP ANY SPACES
0666 E420           XRI     ´ ´
0668 98FA           JZ      $SKIP
066A C5FF           LD      @-1(P1)
066C C100   $LOOP:  LD      (P1)           ;GET A CHARACTER
066E 03             SCL
066F FC3A           CAI     ´9´+1          ;CHECK FOR A NUMERIC CHAR
0671 9409           JP      $LETR
0673 03             SCL
0674 FCF6           CAI     ´0´-´9´-1      ;IF NUMERIC, SHIFT NUMBER
0676 9413           JP      $ENTER         ; AND ADD NEW HEX DIGIT
0678 9032           JMP     $END
067A 90BB   X12C:   JMP     X12B
067C 03     $LETR:  SCL                    ;CHECK FOR HEX LETTER
067D FC0D           CAI     ´G´-´9´-1
067F 942B           JP      $END
0681 03             SCL
0682 FCFA           CAI     ´A´-´G´
0684 9402           JP      $OK
0686 9024           JMP     $END
0688 02     $OK:    CCL                    ;ADD 10 TO GET TRUE VALUE
0689 F40A           ADI     10             ; OF LETTER
068B 01     $ENTER: XAE                    ;NEW DIGIT IN EX REG
```

```
068C C404            LDI     4               ;SET SHIFT COUNTER
068E CAEA            ST      TEMP(P2)
0690 CAEB            ST      NUM(P2)         ;DIGIT COUNT IS NON-ZERO
0692 C3FE  $SHIFT:   LD      -2(P3)          ;SHIFT NUMBER LEFT BY 4
0694 02              CCL
0695 F3FE            ADD     -2(P3)
0697 CBFE            ST      -2(P3)
0699 C3FF            LD      -1(P3)
069B F3FF            ADD     -1(P3)
069D CBFF            ST      -1(P3)
069F BAEA            DLD     TEMP(P2)
06A1 9CEF            JNZ     $SHIFT
06A3 C3FE            LD      -2(P3)          ;ADD NEW DIGIT
06A5 58              ORE                     ; INTO NUMBER
06A6 CBFE            ST      -2(P3)
06A8 C501            LD      @1(P1)          ;ADVANCE THE CURSOR
06AA 90C0            JMP     $LOOP           ;GET NEXT CHAR
06AC C2EB  $END:     LD      NUM(P2)         ;CHECK IF THERE WERE
06AE 9C87            JNZ     X12B            ; MORE THAN 0 CHARACTERS
06B0 C405            LDI     5               ;ERROR IF THERE WERE NONE
06B2 9097  E8B:      JMP     E8


           ;**************************************
           ;*      TEST FOR NUMBER IN TEXT       *
           ;**************************************

           ; THIS ROUTINE TESTS FOR A NUMBER IN THE TEXT.  IF NO
           ; NUMBER IS FOUND, I.L. CONTROL PASSES TO THE ADDRESS
           ; INDICATED IN THE 'TSTN' INSTRUCTION.  OTHERWISE, THE
           ; NUMBER IS SCANNED AND PUT ON THE ARITHMETIC STACK,
           ; WITH I.L. CONTROL PASSING TO THE NEXT INSTRUCTION.

                     .LOCAL
06B4 C501  TSTNUM:   LD      @1(P1)
06B6 E420            XRI     ' '             ;SKIP OVER ANY SPACES
06B8 98FA            JZ      TSTNUM
06BA C5FF            LD      @-1(P1)         ;GET FIRST CHAR
06BC 03              SCL                     ;TEST FOR DIGIT
06BD FC3A            CAI     '9'+1
06BF 9405            JP      $ABORT
06C1 03              SCL
06C2 FCF6            CAI     '0'-'9'-1
06C4 9421            JP      $1
06C6 C2FB  $ABORT:   LD      PCLOW(P2)       ;GET TEST-FAIL ADDRESS
06C8 33              XPAL    P3              ; FROM I.L. TABLE
06C9 C2FA            LD      PCHIGH(P2)
06CB 37              XPAH    P3
06CC C300            LD      (P3)            ;PUT TEST-FAIL ADDRESS
06CE CAFA            ST      PCHIGH(P2)      ; INTO I.L. PC
06D0 C301            LD      1(P3)
06D2 CAFB            ST      PCLOW(P2)
06D4 90A4            JMP     X12C
06D6 C402  $RET:     LDI     2               ;SKIP OVER ONE IL INSTRUCTION
06D8 02              CCL                     ; IF NUMBER IS DONE
06D9 F2FB            ADD     PCLOW(P2)
06DB CAFB            ST      PCLOW(P2)
06DD C400            LDI     0
06DF F2FA            ADD     PCHIGH(P2)
06E1 CAFA            ST      PCHIGH(P2)
06E3 9095  X13:      JMP     X12C
06E5 90CB  E8A:      JMP     E8B
06E7 01    $1:       XAE                     ;SAVE DIGIT IN EX REG
06E8 C410            LDI     H(AESTK)        ;POINT P3 AT AE STACK
06EA 37              XPAH    P3
06EB AAFD            ILD     LSTK(P2)
06ED AAFD            ILD     LSTK(P2)
06EF 33              XPAL    P3
06F0 C400            LDI     0
06F2 CBFF            ST      -1(P3)
06F4 40              LDE
06F5 CBFE            ST      -2(P3)
06F7 C501  $LOOP:    LD      @1(P1)          ;GET NEXT CHAR
06F9 C100            LD      (P1)
```

```
06FB 03                SCL                       ;TEST IF IT IS DIGIT
06FC FC3A              CAI       '9'+1
06FE 94D6              JP        $RET            ;RETURN IF IT ISN'T
0700 03                SCL
0701 FCF6              CAI       '0'-'9'-1
0703 9402              JP        $2
0705 90CF              JMP       $RET
0707 01      $2:       XAE                       ;SAVE DIGIT
0708 C3FF              LD        -1(P3)          ;PUT RESULT IN SCRATCH SPACE
070A CB01              ST        1(P3)
070C C3FE              LD        -2(P3)
070E CB00              ST        (P3)
0710 C402              LDI       2
0712 CAEA              ST        TEMP(P2)        ;MULTIPLY RESULT BY 10
0714 02      $SHIFT:   CCL                       ;FIRST MULTIPLY BY 4
0715 C3FE              LD        -2(P3)
0717 F3FE              ADD       -2(P3)
0719 CBFE              ST        -2(P3)
071B C3FF              LD        -1(P3)
071D F3FF              ADD       -1(P3)
071F CBFF              ST        -1(P3)
0721 BAEA              DLD       TEMP(P2)
0723 9CEF              JNZ       $SHIFT
0725 02                CCL                       ;THEN ADD OLD RESULT,
0726 C3FE              LD        -2(P3)          ; SO WE HAVE RESULT * 5
0728 F300              ADD       (P3)
072A CBFE              ST        -2(P3)
072C C3FF              LD        -1(P3)
072E F301              ADD       1(P3)
0730 CBFF              ST        -1(P3)
0732 02                CCL                       ;THEN MULTIPLY BY TWO
0733 C3FE              LD        -2(P3)
0735 F3FE              ADD       -2(P3)
0737 CBFE              ST        -2(P3)
0739 C3FF              LD        -1(P3)
073B F3FF              ADD       -1(P3)
073D CBFF              ST        -1(P3)
073F 02                CCL                       ;THEN ADD IN NEW DIGIT
0740 40                LDE
0741 F3FE              ADD       -2(P3)
0743 CBFE              ST        -2(P3)
0745 C400              LDI       0
0747 F3FF              ADD       -1(P3)
0749 CBFF              ST        -1(P3)
074B 94AA              JP        $LOOP           ;REPEAT IF NO OVERFLOW
074D C406              LDI       6
074F 9094    E9:       JMP       E8A             ;ELSE REPORT ERROR
0751 9090    X14:      JMP       X13


             ;*************************************
             ;*    GET LINE FROM TELETYPE         *
             ;*************************************

                        LOCAL
0753         GETL:     LDPI      P1,LBUF         ;SET P1 TO LBUF
0759 C400              LDI       0               ;CLEAR NO. OF CHAR
075B CAE7              ST        CHRNUM(P2)
075D                   LDPI      P3,PUTC-1       ;POINT P3 AT PUTC ROUTINE
0763 C2F4              LD        RUNMOD(P2)      ;PRINT '? ' IF RUNNING
0765 9808              JZ        $0              ; (I.E. DURING 'INPUT')
0767 C43F              LDI       '?'
0769 3F                XPPC      P3
076A C420              LDI       ' '
076C 3F                XPPC      P3
076D 9003              JMP       $1
076F C43E    $0:       LDI       '>'             ;OTHERWISE PRINT '>'
0771 3F                XPPC      P3
0772 C40F    $1:       JS        P3,GECO         ;GET CHARACTER
0779 C4BD              LDI       L(PUTC)-1       ;POINT P3 AT PUTC AGAIN
077B 33                XPAL      P3
077C 40                LDE                       ;GET TYPED CHAR
077D 98F3              JZ        $1              ;IGNORE NULLS
077F E40A              XRI       0A              ;IGNORE LINE FEED
```

```
0781 98EF            JZ     $1
0783 40              LDE
0784 E40D            XRI    0D            ;CHECK FOR CR
0786 9850            JZ     $CR
0788 40              LDE
0789 E45F            XRI    'O'+010       ;CHECK FOR SHIFT/O
078B 9841            JZ     $RUB
078D 40              LDE                  ;CHECK FOR CTRL/H
078E E408            XRI    8
0790 9836            JZ     $XH
0792 40              LDE
0793 E415            XRI    015           ;CHECK FOR CTRL/U
0795 980F            JZ     $XU
0797 40              LDE
0798 E403            XRI    3             ;CHECK FOR CTRL/C
079A 9C1A            JNZ    $ENTER
079C C45E            LDI    '^'           ;ECHO CONTROL/C AS ^C
079E 3F              XPPC   P3
079F C443            LDI    'C'
07A1 3F              XPPC   P3
07A2 C40E            LDI    14            ;CAUSE A BREAK
07A4 90A9            JMP    E9
07A6 C45E  $XU:      LDI    '^'           ;ECHO CONTROL/U AS ^U
07A8 3F              XPPC   P3
07A9 C455            LDI    'U'
07AB 3F              XPPC   P3
07AC C40D            LDI    0D            ;PRINT CR/LF
07AE 3F              XPPC   P3
07AF C40A            LDI    0A
07B1 3F              XPPC   P3
07B2 909F  $2:       JMP    GETL          ;GO GET ANOTHER LINE
07B4 909B  X15:      JMP    X14
07B6 40    $ENTER:   LDE
07B7 CD01            ST     @1(P1)        ;PUT CHAR IN LBUF
07B9 AAE7            ILD    CHRNUM(P2)    ;INCREMENT CHRNUM
07BB E448            XRI    72            ;IF=72, LINE FULL
07BD 9CB3            JNZ    $1
07BF C40D            LDI    0D
07C1 01              XAE                  ;SAVE CARRIAGE RET
07C2 40              LDE
07C3 3F              XPPC   P3            ;PRINT IT
07C4 9012            JMP    $CR           ;STORE IT IN LBUF
07C6 9087  E10:      JMP    E9
07C8 C420  $XH:      LDI    ' '           ;BLANK OUT THE CHARACTER
07CA 3F              XPPC   P3
07CB C408            LDI    8             ;PRINT ANOTHER BACKSPACE
07CD 3F              XPPC   P3
07CE C2E7  $RUB:     LD     CHRNUM(P2)
07D0 98A0            JZ     $1
07D2 BAE7            DLD    CHRNUM(P2)    ;ONE LESS CHAR
07D4 C5FF            LD     @-1(P1)       ;BACKSPACE CURSOR
07D6 909A            JMP    $1
07D8 40    $CR:      LDE
07D9 CD01            ST     @1(P1)        ;STORE CR IN LBUF
07DB C40A            LDI    0A            ;PRINT LINE FEED
07DD 3F              XPPC   P3
07DE C410            LDI    H(LBUF)       ;SET P1 TO BEGIN-
07E0 35              XPAH   P1            ; NING OF LBUF
07E1 C4D6            LDI    L(LBUF)
07E3 31              XPAL   P1
07E4 90CE  X16:      JMP    X15


           ;*************************************
           ;*      EVAL -- GET MEMORY CONTENTS   *
           ;*************************************

           ; THIS ROUTINE IMPLEMENTS THE '@' OPERATOR IN EXPRESSIONS

07E6 C410  EVAL:     LDI    H(AESTK)
07E8 37              XPAH   P3
07E9 C2FD            LD     LSTK(P2)
07EB 33              XPAL   P3            ;P3 -> ARITH STACK
07EC C3FF            LD     -1(P3)        ;GET ADDR OFF STACK,
07EE 35                XPAH    P1           ; AND INTO P1,
07EF 01                XAE                  ; SAVING OLD P1 IN EX & LO
07F0 C3FE              LD      -2(P3)
07F2 31                XPAL    P1
07F3 CAEF              ST      LO(P2)
07F5 C100              LD      0(P1)        ;GET MEMORY CONTENTS,
07F7 CBFE              ST      -2(P3)       ; SHOVE ONTO STACK
07F9 C400              LDI     0
07FB CBFF              ST      -1(P3)       ;HIGH ORDER 8 BITS ZEROED
07FD C2EF              LD      LO(P2)
07FF 31                XPAL    P1           ;RESTORE ORIGINAL P1
0800 40                LDE
0801 35                XPAH    P1
0802 90B0              JMP     X15


               ;**************************************
               ;*     MOVE -- STORE INTO MEMORY      *
               ;**************************************

               ; THIS ROUTINE IMPLEMENTS THE STATEMENT:
               ;     '@' FACTOR '=' REL-EXP

0804 C410      MOVE:   LDI     H(AESTK)
0806 37                XPAH    P3
0807 C2FD              LD      LSTK(P2)
0809 33                XPAL    P3           ;P3 -> ARITH STACK
080A C7FE              LD      @-2(P3)      ;GET BYTE TO BE MOVED
080C 01                XAE
080D C7FF              LD      @-1(P3)      ;NOW GET ADDRESS INTO P3
080F CAEA              ST      TEMP(P2)
0811 C7FF              LD      @-1(P3)
0813 33                XPAL    P3
0814 CAFD              ST      LSTK(P2)     ;STACK PTR UPDATED NOW
0816 C2EA              LD      TEMP(P2)
0818 37                XPAH    P3
0819 40                LDE
081A CB00              ST      0(P3)        ;MOVE THE BYTE INTO MEMORY
081C 90C6      X17:    JMP     X16
081E 90A6      E11:    JMP     E10

               ;**************************************
               ;*            TEXT EDITOR             *
               ;**************************************

               ;INPUTS TO THIS ROUTINE: POINTER TO LINE BUFFER IN P1LOW &
               ; P1HIGH.  P1 POINTS TO THE INSERTION POINT IN THE TEXT.
               ; THE A.E. STACK HAS THE LINE NUMBER ON IT (STACK POINTER
               ; IS ALREADY POPPED).

               ;EACH LINE IN THE NIBL TEXT IS STORED IN THE FOLLOWING
               ; FORMAT: TWO BYTES CONTAINING THE LINE NUMBER (IN BINARY,
               ; HIGH ORDER BYTE FIRST), THEN ONE BYTE CONTAINING THE
               ; LENGTH OF THE LINE, AND FINALLY THE LINE ITSELF FOLLOWED
               ; BY A CARRIAGE RETURN.  THE LAST LINE IN THE TEXT IS
               ; FOLLOWED BY TWO CONSECUTIVE BYTES OF X'FF.

                       .LOCAL
0820 C410      INSRT:  LDI     H(AESTK)     ;POINT P3 AT AE STACK,
0822 37                XPAH    P3           ; WHICH HAS THE LINE #
0823 C2FD              LD      LSTK(P2)     ; ON IT
0825 33                XPAL    P3
0826 C301              LD      1(P3)        ;SAVE NEW LINE'S NUMBER
0828 CAF7              ST      HILINE(P2)
082A C300              LD      0(P3)
082C CAF8              ST      LOLINE(P2)
082E C2F1              LD      P1LOW(P2)    ;PUT POINTER TO LBUF INTO P3
0830 33                XPAL    P3
0831 C2F0              LD      P1HIGH(P2)
0833 37                XPAH    P3
0834 C404              LDI     4            ;INITIALLY LENGTH OF NEW LINE
0836 CAE7              ST      CHRNUM(P2)   ; = 4. ADD 1 TO LENGTH FOR
0838 C701      $1:     LD      @1(P3)       ; EACH CHAR IN LINE UP TO, BU
```

```
1447 083A E40D           XRI    0D            ; NOT INCLUDING, CARR. RETURN
1448 083C 9804           JZ     $2
1449 083E AAE7           ILD    CHRNUM(P2)
1450 0840 90F6           JMP    $1
1451 0842 C2E7  $2:      LD     CHRNUM(P2)    ;IF LENGTH STILL 4, WE'LL DEL
1452 0844 E404           XRI    4             ; A LINE, SO SET LENGTH = 0
1453 0846 9C02           JNZ    $3
1454 0848 CAE7           ST     CHRNUM(P2)
1455 084A C2E7  $3:      LD     CHRNUM(P2)    ;PUT NEW LINE LENGTH IN EX
1456 084C 01             XAE
1457 084D C2F2           LD     LABLHI(P2)    ;IS NEW LINE REPLACING OLD?
1458 084F 9406           JP     $4            ;YES - DO REPLACE
1459 0851 D47F           ANI    07F           ;NO - WE'LL INSERT LINE HERE,
1460 0853 CAF2           ST     LABLHI(P2)    ; WHERE FNDLBL GOT US.
1461 0855 9018           JMP    $MOVE         ;BUT FIRST MAKE ROOM
1462 0857 C503  $4:      LD     @3(P1)        ;SKIP LINE # AND LENGTH
1463 0859 40             LDE                  ;EX, NOW HOLDING NEW LINE
1464 085A 02             CCL                  ; LENGTH, WILL SOON HOLD
1465 085B F4FC           ADI    -4            ; DISPLACEMENT OF LINES
1466 085D 01             XAE                  ; TO BE MOVED
1467 085E C501  $5:      LD     @1(P1)        ;SUBTRACT 1 FROM DISPLACEMENT
1468 0860 E40D           XRI    0D            ; FOR EACH CHAR IN LINE BEING
1469 0862 980B           JZ     $MOVE         ; REPLACED
1470 0864 40             LDE
1471 0865 02             CCL
1472 0866 F4FF           ADI    -1
1473 0868 01             XAE
1474 0869 90F3           JMP    $5
1475 086B 90AF  X19:     JMP    X17
1476 086D 90AF  E12:     JMP    E11
1477 086F 40    $MOVE:   LDE                  ;IF DISPLACEMENT AND LENGTH
1478 0870 DAE7           OR     CHRNUM(P2)    ; OF NEW LINE ARE 0, RETURN
1479 0872 98F7           JZ     X19
1480 0874 C47A           LDI    L(DOSTAK)     ;CLEAR SOME STACKS
1481 0876 CAFF           ST     DOPTR(P2)
1482 0878 C46A           LDI    L(SBRSTK)
1483 087A CAFC           ST     SBRPTR(P2)
1484 087C C48A           LDI    L(FORSTK)
1485 087E CAFE           ST     FORPTR(P2)
1486 0880 40             LDE
1487 0881 9860           JZ     $ADD          ;DON'T NEED TO MOVE LINES
1488 0883 9410           JP     $UP           ;SKIP IF DISPLACEMENT POSITIV
1489 0885 C100  $DOWN:   LD     0(P1)         ;NEGATIVE DISPLACEMENT:
1490 0887 C980           ST     EREG(P1)      ;DO;
1491 0889 C501           LD     @1(P1)        ;    M(P1+DISP) = M(P1);
1492 088B 94F8           JP     $DOWN         ;    P1 = P1+1;
1493 088D C100           LD     0(P1)         ;UNTIL M(P1)<0 & M(P1-1)<0;
1494 088F 94F4           JP     $DOWN
1495 0891 C980           ST     EREG(P1)      ;M(P1+DISP) = M(P1);
1496 0893 904E           JMP    $ADD
1497 0895 C1FE  $UP:     LD     -2(P1)        ;POSITIVE DISPLACEMENT:
1498 0897 CAEA           ST     TEMP(P2)      ;FLAG BEGINNING OF MOVE WITH
1499 0899 C4FF           LDI    -1            ; A -1 FOLLOWED BY 80, WHICH
1500 089B C9FE           ST     -2(P1)        ; CAN NEVER APPEAR IN A
1501 089D C450           LDI    80            ; NIBL TEXT
1502 089F C9FF           ST     -1(P1)
1503 08A1 C501  $UP1:    LD     @1(P1)        ;ADVANCE P1 TO END OF TEXT
1504 08A3 94FC           JP     $UP1
1505 08A5 C100           LD     0(P1)
1506 08A7 94F8           JP     $UP1
1507 08A9 35             XPAH   P1            ;SAVE P1 IN LO, HI
1508 08AA CAEE           ST     HI(P2)
1509 08AC 35             XPAH   P1
1510 08AD 31             XPAL   P1
1511 08AE CAEF           ST     LO(P2)
1512 08B0 31             XPAL   P1
1513 08B1 C2EF           LD     LO(P2)        ;ADD DISPLACEMENT TO
1514 08B3 02             CCL                  ; VALUE OF P1, TO CHECK
1515 08B4 70             ADE                  ; WHETHER WE'RE OUT OF
1516 08B5 C400           LDI    0             ; RAM FOR USER'S PROGRAM
1517 08B7 F2EE           ADD    HI(P2)
1518 08B9 E2EE           XOR    HI(P2)
1519 08BB D4F0           ANI    0F0
```

```
08BD 9803            JZ      $UP2
08BF C400            LDI     0               ;IF OUT OF RAM, CHANGE
08C1 01              XAE                     ; DISPLACEMENT TO ZERO
08C2 C4FF   $UP2:    LDI     -1
08C4 C980   $UP3:    ST      EREG(P1)        ;MOVE TEXT UP UNTIL WE REACH
08C6 C5FF            LD      @-1(P1)         ; THE FLAGS SET ABOVE
08C8 94FA            JP      $UP3
08CA C101            LD      1(P1)
08CC E450            XRI     80
08CE 9804            JZ      $UP4
08D0 C100            LD      0(P1)
08D2 90F0            JMP     $UP3
08D4 C2EA   $UP4:    LD      TEMP(P2)        ;RESTORE THE FLAGGED LOCATION
08D6 C900            ST      0(P1)           ; TO THEIR ORIGINAL VALUES
08D8 C40D            LDI     0D
08DA C901            ST      1(P1)
08DC 40              LDE                     ;IF DISPLACEMENT = 0, WE'RE
08DD 9C04            JNZ     $ADD            ; OUT OF RAM, SO REPORT ERROR
08DF C402            LDI     2
08E1 908A   E12A:    JMP     E12
08E3 C2E7   $ADD:    LD      CHRNUM(P2)      ;INSERT NEW LINE
08E5 9884   X19A:    JZ      X19             ; UNLESS LENGTH IS ZERO
08E7 C2F1            LD      P1LOW(P2)       ;POINT P1 AT LINE BUFFER
08E9 31              XPAL    P1
08EA C2F0            LD      P1HIGH(P2)
08EC 35              XPAH    P1
08ED C2F3            LD      LABLLO(P2)      ;POINT P3 AT INSERTION PLACE
08EF 33              XPAL    P3
08F0 C2F2            LD      LABLHI(P2)
08F2 37              XPAH    P3
08F3 C2F7            LD      HILINE(P2)      ;PUT LINE NUMBER INTO TEXT
08F5 CF01            ST      @1(P3)
08F7 C2F8            LD      LOLINE(P2)
08F9 CF01            ST      @1(P3)
08FB C2E7            LD      CHRNUM(P2)      ;STORE LINE LENGTH IN TEXT
08FD CF01            ST      @1(P3)
08FF C501   $ADD1:   LD      @1(P1)          ;PUT REST OF CHARS
0901 CF01            ST      @1(P3)          ; (INCLUDING CR) INTO TEXT
0903 E40D            XRI     0D
0905 9CF8            JNZ     $ADD1
0907 90DC            JMP     X19A            ;RETURN
0909 C400   X20:     JS      P3,EXECIL
0910 90CF   E13:     JMP     E12A


            ;*************************************
            ;*       POP ARITHMETIC STACK        *
            ;*************************************

0912 BAFD   POPAE:   DLD     LSTK(P2)        ;THIS ROUTINE POP THE A.E.
0914 BAFD            DLD     LSTK(P2)        ; STACK, AND PUTS THE RESULT
0916 33              XPAL    P3              ; INTO LO(P2) AND HI(P2)
0917 C410            LDI     H(AESTK)
0919 37              XPAH    P3
091A C300            LD      (P3)
091C CAEF            ST      LO(P2)
091E C301            LD      1(P3)
0920 CAEE            ST      HI(P2)
0922 90E5            JMP     X20


            ;**************************************
            ;*               UNTIL                *
            ;**************************************

                     .LOCAL
0924 C2FF   UNTIL:   LD      DOPTR(P2)       ;CHECK FOR DO-STACK UNDERFLOW
0926 01              XAE
0927 40              LDE
0928 E47A            XRI     L(DOSTAK)
092A 9C04            JNZ     $1
092C C40F            LDI     15
092E 90E0            JMP     E13
0930 C2EF   $1:      LD      LO(P2)          ;CHECK FOR EXPRESSION = 0
```

```
0932 DAEE              OR     HI(P2)
0934 9806              JZ     $REDO         ;IF ZERO, REPEAT DO-LOOP
0936 BAFF              DLD    DOPTR(P2)     ;ELSE POP SAVE STACK
0938 BAFF              DLD    DOPTR(P2)
093A 90CD              JMP    X20           ;CONTINUE TO NEXT STMT
093C 40       $REDO:   LDE                  ;POINT P3 AT DO-STACK
093D 33                XPAL   P3
093E C410              LDI    H(DOSTAK)
0940 37                XPAH   P3
0941 C3FF              LD     -1(P3)        ;LOAD P1 FROM DO STACK
0943 35                XPAH   P1
0944 C3FE              LD     -2(P3)
0946 31                XPAL   P1            ;CURSOR NOW POINTS TO FIRST
0947 90C0              JMP    X20           ; STATEMENT OF DO-LOOP


                  ;*************************************
                  ;*     STORE INTO STATUS REGISTER    *
                  ;*************************************

                  ; THIS ROUTINE IMPLEMENTS THE STATEMENT:
                  ;       'STAT' '=' REL-EXP

0949 C2EF     MOVESR:  LD     LO(P2)        ;LOW BYTE GOES TO STATUS
094B D4F7              ANI    0F7           ; BUT WITH IEN BIT CLEARED
094D 07                CAS
094E 90B9     X21:     JMP    X20
0950 90BE     E14:     JMP    E13


                  ;*************************************
                  ;*          STAT FUNCTION            *
                  ;*************************************

0952 C410     STATUS:  LDI    H(AESTK)
0954 37                XPAH   P3            ;POINT P3 AT AE STACK
0955 AAFD              ILD    LSTK(P2)
0957 AAFD              ILD    LSTK(P2)
0959 33                XPAL   P3
095A 06                CSA
095B CBFE              ST     -2(P3)        ;STATUS REG IS LOW BYTE
095D C400              LDI    0
095F CBFF              ST     -1(P3)        ;ZERO IS HIGH BYTE
0961 90EB              JMP    X21


                  ;*************************************
                  ;*    MACHINE LANGUAGE SUBROUTINE    *
                  ;*************************************

                  ; THIS ROUTINE IMPLEMENTS THE 'LINK' STATEMENT

0963 C2EE     CALLML:  LD     HI(P2)        ;GET HIGH BYTE OF ADDRESS
0965 37                XPAH   P3
0966 C2EF              LD     LO(P2)        ;GET LOW BYTE
0968 33                XPAL   P3            ;P3 -> USER'S ROUTINE
0969 C7FF              LD     @-1(P3)       ;CORRECT P3
096B 3F                XPPC   P3            ;CALL ROUTINE (PRAY IT WORKS)
096C                   LDPI   P2,VARS       ;RESTORE RAM POINTER
0972 90DA              JMP    X21           ;RETURN


                  ;*************************************
                  ;*        SAVE DO LOOP ADDRESS       *
                  ;*************************************

                  ; THIS ROUTINE IMPLEMENTS THE 'DO' STATEMENT.

                       .LOCAL
0974 C2FF     SAVEDO:  LD     DOPTR(P2)     ;CHECK FOR STACK OVERFLOW
0976 E48A              XRI    L(FORSTK)
0978 9C04              JNZ    $1
097A C40A              LDI    10
097C 90D2     E15:     JMP    E14
```

```
097E AAFF    $1:     ILD     DOPTR(P2)
0980 AAFF            ILD     DOPTR(P2)
0982 33              XPAL    P3
0983 C410            LDI     H(DOSTAK)
0985 37              XPAH    P3             ;P3 -> TOP OF DO STACK
0986 35              XPAH    P1             ;SAVE CURSOR ON THE STACK
0987 CBFF            ST      -1(P3)
0989 35              XPAH    P1
098A 31              XPAL    P1
098B CBFE            ST      -2(P3)
098D 31              XPAL    P1
098E 90BE    X22:    JMP     X21


             ;************************************
             ;*         TOP OF RAM FUNCTION      *
             ;************************************

                     .LOCAL
0990 C2E9    TOP:    LD      TEMP2(P2)      ;SET P3 TO POINT TO
0992 37              XPAH    P3             ; START OF NIBL TEXT
0993 C2E8            LD      TEMP3(P2)
0995 33              XPAL    P3
0996 C300    $0:     LD      (P3)           ;HAVE WE HIT END OF TEXT?
0998 9402            JP      $1             ;NO - SKIP TO NEXT LINE
099A 9007            JMP     $2             ;YES - PUT CURSOR ON STACK
099C C302    $1:     LD      2(P3)          ;GET LENGTH OF LINE
099E 01              XAE
099F C780            LD      @EREG(P3)      ;SKIP TO NEXT LINE
09A1 90F3            JMP     $0             ;GO CHECK FOR EOF
09A3 C702    $2:     LD      @2(P3)         ;P3 := P3 + 2
09A5 AAFD            ILD     LSTK(P2)       ;SET P3 TO STACK, SAVING
09A7 AAFD            ILD     LSTK(P2)       ; OLD P3 (WHICH CONTAINS TOP)
09A9 33              XPAL    P3             ; ON IT SOMEHOW
09AA 01              XAE
09AB C410            LDI     H(AESTK)
09AD 37              XPAH    P3
09AE CBFF            ST      -1(P3)
09B0 40              LDE
09B1 CBFE            ST      -2(P3)
09B3 90D9            JMP     X22


             ;************************************
             ;*       SKIP TO NEXT NIBL LINE     *
             ;************************************

09B5 C501    IGNORE: LD      @1(P1)         ;SCAN TIL WE'RE PAST
09B7 E40D            XRI     0D             ; CARRIAGE RETURN
09B9 9CFA            JNZ     IGNORE
09BB 3F              XPPC    P3             ;YES - RETURN


             ;************************************
             ;*          MODULO FUNCTION         *
             ;************************************

09BC C2FD    MODULO: LD      LSTK(P2)       ;THIS ROUTINE MUST BE
09BE 33              XPAL    P3             ; IMMEDIATELY AFTER A
09BF C410            LDI     H(AESTK)       ; DIVIDE TO WORK CORRECTLY
09C1 37              XPAH    P3
09C2 C303            LD      3(P3)          ;GET LOW BYTE OF REMAINDER
09C4 CBFE            ST      -2(P3)         ;PUT ON STACK
09C6 C302            LD      2(P3)          ;GET HIGH BYTE OF REMAINDER
09C8 CBFF            ST      -1(P3)         ;PUT ON STACK
09CA 90C2    X23:    JMP     X22
09CC 90AE    E16:    JMP     E15


             ;************************************
             ;*          RANDOM FUNCTION         *
             ;************************************

                     .LOCAL
```

```
09CE C408  RANDOM  LDI    8                ;LOOP COUNTER FOR MULTIPLY
09D0 CAEB          ST     NUM(P2)
09D2 C2E5          LD     RNDX(P2)
09D4 01            XAE
09D5 C2E4          LD     RNDY(P2)
09D7 CAE9          ST     TEMP2(P2)
09D9 C2E5  $LOOP   LD     RNDX(P2)         ;MULTIPLY THE SEEDS BY 9
09DB 02            CCL
09DC 70            ADE
09DD 01            XAE
09DE C2E4          LD     RNDY(P2)
09E0 02            CCL
09E1 F2E9          ADD    TEMP2(P2)
09E3 CAE4          ST     RNDY(P2)
09E5 BAEB          DLD    NUM(P2)
09E7 9CF0          JNZ    $LOOP
09E9 40            LDE                     ;ADD 7 TO SEEDS
09EA 02            CCL
09EB F407          ADI    7
09ED 01            XAE
09EE C2E4          LD     RNDY(P2)
09F0 02            CCL
09F1 F407          ADI    7
09F3 1E            RR
09F4 CAE4          ST     RNDY(P2)
09F6 AAE6          ILD    RNDF(P2)         ;HAVE WE GONE THROUGH
09F8 9803          JZ     $1               ; 256 GENERATIONS?
09FA 40            LDE                     ;IF SO, SKIP GENERATING
09FB CAE5          ST     RNDX(P2)         ; THE NEW RNDX
09FD C2FD  $1      LD     LSTK(P2)         ;START MESSING WITH THE STACK
09FF 33            XPAL   P3
0A00 C410          LDI    H(AESTK)
0A02 37            XPAH   P3
0A03 C401          LDI    1                ;FIRST PUT 1 ON STACK
0A05 CB00          ST     (P3)
0A07 C400          LDI    0
0A09 CB01          ST     1(P3)
0A0B C3FE          LD     -2(P3)           ;PUT EXPR2 ON STACK
0A0D CB02          ST     2(P3)
0A0F C3FF          LD     -1(P3)
0A11 CB03          ST     3(P3)
0A13 C3FC          LD     -4(P3)           ;PUT EXPR1 ON STACK
0A15 CB04          ST     4(P3)
0A17 C3FD          LD     -3(P3)
0A19 CB05          ST     5(P3)
0A1B C2E4          LD     RNDY(P2)         ;PUT RANDOM # ON STACK
0A1D CBFE          ST     -2(P3)
0A1F C2E5          LD     RNDX(P2)
0A21 E4FF          XRI    0FF
0A23 D47F          ANI    07F
0A25 CBFF          ST     -1(P3)
0A27 C706          LD     @6(P3)           ;ADD 6 TO STACK POINTER
0A29 33            XPAL   P3
0A2A CAFD          ST     LSTK(P2)
0A2C 909C  X24     JMP    X23
0A2E 909C  E16A    JMP    E16


           ;************************************
           ;*     PUSH 1 ON ARITHMETIC STACK    *
           ;************************************

0A30 AAFD  LIT1    ILD    LSTK(P2)
0A32 AAFD          ILD    LSTK(P2)
0A34 33            XPAL   P3
0A35 C410          LDI    H(AESTK)
0A37 37            XPAH   P3
0A38 C400          LDI    0
0A3A CBFF          ST     -1(P3)
0A3C C401          LDI    1
0A3E CBFE          ST     -2(P3)
0A40 90EA          JMP    X24
```

```
             ;*************************************
             ;*      FOR-LOOP INITIALIZATION      *
             ;*************************************

                     LOCAL
0A42 C2FE    SAVFOR: LD      FORPTR(P2)       ;CHECK FOR FOR STACK
0A44 E4A6            XRI     L(PCSTAK)        ; OVERFLOW
0A46 9C04            JNZ     $1
0A48 C40A            LDI     10
0A4A 90E2    E17:    JMP     E16A
0A4C E4A6    $1:     XRI     L(PCSTAK)
0A4E 31              XPAL    P1               ;POINT P1 AT FOR STACK
0A4F CAF1            ST      P1LOW(P2)        ; SAVING OLD P1
0A51 C410            LDI     H(FORSTK)
0A53 35              XPAH    P1
0A54 CAF0            ST      P1HIGH(P2)
0A56 C2FD            LD      LSTK(P2)         ;POINT P3 AT AE STACK
0A58 33              XPAL    P3
0A59 C410            LDI     H(AESTK)
0A5B 37              XPAH    P3
0A5C C3F9            LD      -7(P3)           ;GET VARIABLE INDEX
0A5E CD01            ST      @1(P1)           ;SAVE ON FOR-STACK
0A60 C3FC            LD      -4(P3)           ;GET L(LIMIT)
0A62 CD01            ST      @1(P1)           ;SAVE
0A64 C3FD            LD      -3(P3)           ;GET H(LIMIT)
0A66 CD01            ST      @1(P1)           ;SAVE
0A68 C3FE            LD      -2(P3)           ;GET L(STEP)
0A6A CD01            ST      @1(P1)           ;SAVE
0A6C C3FF            LD      -1(P3)           ;GET H(STEP)
0A6E CD01            ST      @1(P1)           ;SAVE
0A70 C2F1            LD      P1LOW(P2)        ;GET L(P1)
0A72 CD01            ST      @1(P1)           ;SAVE
0A74 C2F0            LD      P1HIGH(P2)       ;GET H(P1)
0A76 CD01            ST      @1(P1)           ;SAVE
0A78 35              XPAH    P1               ;RESTORE OLD P1
0A79 C2F1            LD      P1LOW(P2)
0A7B 31              XPAL    P1
0A7C CAFE            ST      FORPTR(P2)       ;UPDATE FOR STACK PTR
0A7E C7FC            LD      @-4(P3)
0A80 33              XPAL    P3
0A81 CAFD            ST      LSTK(P2)         ;UPDATE AE STACK PTR
0A83 90A7    X25:    JMP     X24


             ;*************************************
             ;*     FIRST PART OF 'NEXT VAR'      *
             ;*************************************

                     .LOCAL
0A85 C2FE    NEXTV:  LD      FORPTR(P2)       ;POINT P1 AT FOR STACK,
0A87 E48A            XRI     L(FORSTK)        ; CHECKING FOR UNDERFLOW
0A89 9C04            JNZ     $1
0A8B C40B            LDI     11               ;REPORT ERROR
0A8D 90BB            JMP     E17
0A8F E48A    $1:     XRI     L(FORSTK)
0A91 31              XPAL    P1
0A92 CAF1            ST      P1LOW(P2)        ;SAVE OLD P1
0A94 C410            LDI     H(FORSTK)
0A96 35              XPAH    P1
0A97 CAF0            ST      P1HIGH(P2)
0A99 C2FD            LD      LSTK(P2)         ;POINT P3 AT AE STACK
0A9B 33              XPAL    P3
0A9C C410            LDI     H(AESTK)
0A9E 37              XPAH    P3
0A9F C7FF            LD      @-1(P3)          ;GET VARIABLE INDEX
0AA1 E1F9            XOR     -7(P1)           ;COMPARE WITH INDEX
0AA3 9804            JZ      $10              ; ON FOR STACK: ERROR
0AA5 C40C            LDI     12               ; IF NOT EQUAL
0AA7 90A1    E18:    JMP     E17
0AA9 E1F9    $10:    XOR     -7(P1)           ;RESTORE INDEX
0AAB 01              XAE                      ;SAVE IN EREG
0AAC C280            LD      EREG(P2)         ;GET L(VARIABLE)
0AAE 02              CCL
0AAF F1FC            ADD     -4(P1)           ;ADD L(STEP)
```

```
0AB1 CA80              ST      EREG(P2)        ;STORE IN VARIABLE
0AB3 CB00              ST      (P3)            ; AND ON STACK
0AB5 C601              LD      @1(P2)          ;INCREMENT RAM PTR
0AB7 C280              LD      EREG(P2)        ;GET H(VARIABLE)
0AB9 F1FD              ADD     -3(P1)          ;ADD H(STEP)
0ABB CA80              ST      EREG(P2)        ;STORE IN VARIABLE
0ABD CB01              ST      1(P3)           ; AND ON STACK
0ABF C6FF              LD      @-1(P2)         ;RESTORE RAM POINTER
0AC1 C1FA              LD      -6(P1)          ;GET L(LIMIT)
0AC3 CB02              ST      2(P3)           ;PUT ON STACK
0AC5 C1FB              LD      -5(P1)          ;GET H(LIMIT)
0AC7 CB03              ST      3(P3)           ;PUT ON STACK
0AC9 C1FD              LD      -3(P1)          ;GET H(STEP)
0ACB 9410              JP      $2              ;IF NEGATIVE, INVERT
0ACD C404              LDI     4               ; ITEMS ON A.E. STACK
0ACF CAEB              ST      NUM(P2)         ;NUM = LOOP COUNTER
0AD1 C701    $LOOP:    LD      @1(P3)          ;GET BYTE FROM STACK
0AD3 E4FF              XRI     0FF             ;INVERT IT
0AD5 CBFF              ST      -1(P3)          ;PUT BACK ON STACK
0AD7 BAEB              DLD     NUM(P2)         ;DO UNTIL NUM = 0
0AD9 9CF6              JNZ     $LOOP
0ADB 9002              JMP     $3
0ADD C704    $2:       LD      @4(P3)          ;UPDATE AE STACK POINTER
0ADF 33      $3:       XPAL    P3
0AE0 CAFD              ST      LSTK(P2)
0AE2 C2F1              LD      P1LOW(P2)       ;RESTORE OLD P1
0AE4 31                XPAL    P1
0AE5 C2F0              LD      P1HIGH(P2)
0AE7 35                XPAH    P1
0AE8 9099    X26:      JMP     X25


             ;*************************************
             ;*      SECOND PART OF 'NEXT VAR'     *
             ;*************************************

0AEA C2EF    NEXTV1:   LD      LO(P2)          ;IS FOR-LOOP OVER WITH?
0AEC 9808              JZ      $REDO           ;NO - REPEAT LOOP
0AEE C2FE              LD      FORPTR(P2)      ;YES - POP FOR-STACK
0AF0 02                CCL
0AF1 F4F9              ADI     -7
0AF3 CAFE              ST      FORPTR(P2)
0AF5 3F                XPPC    P3              ;RETURN TO I.L. INTERPRETER
0AF6 C2FE    $REDO:    LD      FORPTR(P2)      ;POINT P3 AT FOR STACK
0AF8 33                XPAL    P3
0AF9 C410              LDI     H(FORSTK)
0AFB 37                XPAH    P3
0AFC C3FF              LD      -1(P3)          ;GET OLD P1 OFF STACK
0AFE 35                XPAH    P1
0AFF C3FE              LD      -2(P3)
0B01 31                XPAL    P1
0B02 90E4              JMP     X26
0B04 90A1    E19:      JMP     E18


             ;************************************
             ;*       PRINT MEMORY AS STRING     *
             ;************************************

             ; THIS ROUTINE IMPLEMENTS THE STATEMENT:
             ;       'PRINT' '$' FACTOR

                       .LOCAL
0B06 C2EE    PSTRNG:   LD      HI(P2)          ;POINT P1 AT STRING TO PRINT
0B08 35                XPAH    P1
0B09 C2EF              LD      LO(P2)
0B0B 31                XPAL    P1
0B0C                   LDPI    P3,PUTC-1       ;POINT P3 AT PUTC ROUTINE
0B12 C501    $1:       LD      @1(P1)          ;GET A CHARACTER
0B14 E40D              XRI     0D              ;IS IT A CARRIAGE RETURN?
0B16 98D0              JZ      X26             ;YES - WE'RE DONE
0B18 E40D              XRI     0D              ;NO - PRINT THE CHARACTER
0B1A 3F                XPPC    P3
```

```
0B1B 06              CSA                    ;MAKE SURE NO ONE IS
0B1C D420            ANI      020           ; TYPING ON THE TTY
0B1E 9CF2            JNZ      $1            ; BEFORE REPEATING LOOP
0B20 90C6            JMP      X26


          ;***********************************
          ;*        INPUT A STRING           *
          ;***********************************

          ; THIS ROUTINE IMPLEMENTS THE STATEMENT:
          ;       'INPUT' '$' FACTOR

0B22 C2EE ISTRNG:    LD       HI(P2)        ;GET ADDRESS TO STORE THE
0B24 37              XPAH     P3            ; STRING, PUT IT INTO P3
0B25 C2EF            LD       LO(P2)
0B27 33              XPAL     P3
0B28 C501 $2:        LD       @1(P1)        ;GET A BYTE FROM LINE BUFFER
0B2A CF01            ST       @1(P3)        ;PUT IT IN SPECIFIED LOCATION
0B2C E40D            XRI      0D            ;DO UNTIL CHAR = CARR. RETURN
0B2E 9CF8            JNZ      $2
0B30 90B6 X27:       JMP      X26


          ;***********************************
          ;*   STRING CONSTANT ASSIGNMENT    *
          ;***********************************

          ; THIS ROUTINE IMPLEMENTS THE STATEMENT:
          ;       '$' FACTOR '=' STRING

                     .LOCAL
0B32 C2EF PUTSTR:    LD       LO(P2)        ;GET ADDRESS TO STORE STRING,
0B34 33              XPAL     P3            ; PUT IT INTO P3
0B35 C2EE            LD       HI(P2)
0B37 37              XPAH     P3
0B38 C501 $LOOP:     LD       @1(P1)        ;GET A BYTE FROM STRING
0B3A E422            XRI      '"'           ;CHECK FOR END OF STRING
0B3C 980E            JZ       $END
0B3E E42F            XRI      '"' ! 0D      ;MAKE SURE THERE'S NO CR
0B40 9C04            JNZ      $1
0B42 C407            LDI      7
0B44 90BE            JMP      E19           ;ERROR IF CARRIAGE RETURN
0B46 E40D $1:        XRI      0D            ;RESTORE CHARACTER
0B48 CF01            ST       @1(P3)        ;PUT IN SPECIFIED LOCATION
0B4A 90EC            JMP      $LOOP         ;GET NEXT CHARACTER
0B4C C40D $END:      LDI      0D            ;APPEND CARRIAGE RETURN
0B4E CB00            ST       (P3)          ; TO STRING
0B50 90DE            JMP      X27


          ;***********************************
          ;*          MOVE STRING            *
          ;***********************************

          ; THIS ROUTINE IMPLEMENTS THE STATEMENT:
          ;       '$' FACTOR '=' '$' FACTOR

                     .LOCAL
0B52 C2FD MOVSTR:    LD       LSTK(P2)      ;POINT P3 AT A.E. STACK
0B54 33              XPAL     P3
0B55 C410            LDI      H(AESTK)
0B57 37              XPAH     P3
0B58 C7FF            LD       @-1(P3)       ;GET ADDRESS OF SOURCE STRING
0B5A 35              XPAH     P1            ; INTO P1
0B5B C7FF            LD       @-1(P3)
0B5D 31              XPAL     P1
0B5E C7FF            LD       @-1(P3)       ;GET ADDRESS OF DESTINATION
0B60 01              XAE                    ; STRING INTO P3
0B61 C7FF            LD       @-1(P3)
0B63 33              XPAL     P3
0B64 CAFD            ST       LSTK(P2)      ;UPDATE STACK POINTER
0B66 40              LDE
```

```
0B67 37                XPAH    P3
0B68 C501    $LOOP:    LD      @1(P1)          ;GET A SOURCE CHARACTER
0B6A CF01              ST      @1(P3)          ;SEND IT TO DESTINATION
0B6C E40D              XRI     0D              ;REPEAT UNTIL CARRIAGE RET.
0B6E 98C0              JZ      X27
0B70 06                CSA                     ; OR KEYBOARD INTERRUPT
0B71 D420              ANI     020
0B73 9CF3              JNZ     $LOOP
0B75 90B9              JMP     X27


                 ;***********************************
                 ;*     PUT PAGE NUMBER ON STACK    *
                 ;***********************************

0B77 AAFD    PUTPGE:   ILD     LSTK(P2)
0B79 AAFD              ILD     LSTK(P2)
0B7B 33                XPAL    P3
0B7C C410              LDI     H(AESTK)
0B7E 37                XPAH    P3
0B7F C2F6              LD      PAGE(P2)
0B81 CBFE              ST      -2(P3)
0B83 C400              LDI     0
0B85 CBFF              ST      -1(P3)
0B87 90A7              JMP     X27


                 ;***********************************
                 ;*        ASSIGN NEW PAGE          *
                 ;***********************************

                       .LOCAL
0B89 C2EF    NUPAGE:   LD      LO(P2)          ;GET PAGE # FROM STACK,
0B8B D407              ANI     7               ; GET THE LOW 3 BITS
0B8D 9C02              JNZ     $0              ;PAGE 0 BECOMES PAGE 1
0B8F C401              LDI     1
0B91 CAF6    $0:       ST      PAGE(P2)
0B93 3F                XPPC    P3              ;RETURN


                 ;************************************
                 ;*        FIND START OF PAGE        *
                 ;************************************

                 ; THIS ROUTINE COMPUTES THE START OF THE CURRENT TEXT PAGE,
                 ; STORING THE ADDRESS IN TEMP2(P2) [THE HIGH BYTE], AND
                 ; TEMP3(P2) [THE LOW BYTE].

0B94 C2F6    FNDPGE:   LD      PAGE(P2)
0B96 E401              XRI     1               ;SPECIAL CASE IS PAGE 1, BUT
0B98 9C09              JNZ     $1              ; OTHERS ARE CONVENTIONAL
0B9A C411              LDI     H(PGM)          ;PAGE 1 STARTS AT 'PGM'
0B9C CAE9              ST      TEMP2(P2)
0B9E C420              LDI     L(PGM)
0BA0 CAE8              ST      TEMP3(P2)
0BA2 3F                XPPC    P3              ;RETURN
0BA3 E401    $1:       XRI     1               ;RESTORE PAGE #
0BA5 01                XAE                     ;SAVE IT
0BA6 C404              LDI     4               ;LOOP COUNTER = 4
0BA8 CAEB              ST      NUM(P2)
0BAA 40      $LOOP:    LDE                     ;MULTIPLY PAGE# BY 16
0BAB 02                CCL
0BAC 70                ADE
0BAD 01                XAE
0BAE BAEB              DLD     NUM(P2)
0BB0 9CF8              JNZ     $LOOP
0BB2 40                LDE
0BB3 CAE9              ST      TEMP2(P2)       ;TEMP2 HAS HIGH BYTE
0BB5 C402              LDI     2               ; OF ADDRESS NOW
0BB7 CAE8              ST      TEMP3(P2)       ;LOW BYTE IS ALWAYS 2
0BB9 3F                XPPC    P3


```

```
                   ;************************************
                   ;*      MOVE CURSOR TO NEW PAGE     *
                   ;************************************

OBBA C2E9  CHPAGE: LD      TEMP2(P2)        ;PUT START OF PAGE
OBBC 35            XPAH    P1               ; INTO P1.  THIS ROUTINE
OBBD C2E8          LD      TEMP3(P2)        ; MUST BE CALLED RIGHT
OBBF 31            XPAL    P1               ; AFTER 'FNDPGE'
OBC0 3F            XPPC    P3               ;RETURN


                   ;************************************
                   ;*      DETERMINE CURRENT PAGE      *
                   ;************************************

OBC1 35    DETPGE: XPAH    P1               ;CURRENT PAGE IS HIGH
OBC2 01            XAE                      ; PART OF CURSOR DIVIDED
OBC3 40            LDE                      ; BY 16
OBC4 35            XPAH    P1
OBC5 40            LDE
OBC6 1C            SR
OBC7 1C            SR
OBC8 1C            SR
OBC9 1C            SR
OBCA CAF6          ST      PAGE(P2)
OBCC 3F            XPPC    P3               ;RETURN


                   ;************************************
                   ;*        CLEAR CURRENT PAGE        *
                   ;************************************

OBCD C2E9  NEWPGM: LD      TEMP2(P2)        ;POINT P1 AT CURRENT PAGE
OBCF 35            XPAH    P1
OBD0 C2E8          LD      TEMP3(P2)
OBD2 31            XPAL    P1
OBD3 C40D          LDI     OD               ;PUT DUMMY END-OF-LINE
OBD5 C9FF          ST      -1(P1)           ; JUST BEFORE TEXT
OBD7 C4FF          LDI     -1               ;PUT -1 AT START OF TEXT
OBD9 C900          ST      (P1)
OBDB C901          ST      1(P1)
OBDD 3F            XPPC    P3               ;RETURN


                   ;************************************
                   ;*      FIND LINE NUMBER IN TEXT    *
                   ;************************************

                   ;INPUTS: THE START OF THE CURRENT PAGE IN TEMP2 AND TEMP3.
                   ;        THE LINE NUMBER TO LOOK FOR IN LO AND HI.
                   ;OUPUTS: THE ADDRESS OF THE FIRST LINE IN THE NIBL TEXT
                   ;        WHOSE LINE NUMBER IS GREATER THAN OR EQUAL TO THE
                   ;        NUMBER IN HI AND LO, RETURNED IN ADRLO AND ADRHI

                          .LOCAL
OBDE C2E9  FNDLBL: LD      TEMP2(P2)        ;POINT P1 AT START OF TEXT
OBE0 35            XPAH    P1
OBE1 C2E8          LD      TEMP3(P2)
OBE3 31            XPAL    P1
OBE4 C100  $1      LD      (P1)             ;HAVE WE HIT END OF TEXT?
OBE6 E4FF          XRI     OFF
OBE8 9412          JP      $2               ;YES - STOP LOOKING
OBEA 03            SCL                      ;NO - COMPARE LINE NUMBERS
OBEB C101          LD      1(P1)            ; BY SUBTRACTING
OBED FAEF          CAD     LO(P2)
OBEF C100          LD      0(P1)
OBF1 FAEE          CAD     HI(P2)           ;IS TEXT LINE # >= LINE #?
OBF3 9407          JP      $2               ;YES - STOP LOOKING
OBF5 C102          LD      2(P1)            ;NO - TRY NEXT LINE IN TEXT
OBF7 01            XAE
OBF8 C580          LD      @EREG(P1)        ; SKIP LENGTH OF LINE
OBFA 90E8          JMP     $1
OBFC 31    $2:     XPAL    P1               ;SAVE ADDRESS OF FOUND LINE
```

```
0BFD CAF3              ST      LABLLO(P2)        ; IN LABLHI AND LABLLO
0BFF 31                XPAL    P1
0C00 35                XPAH    P1
0C01 CAF2              ST      LABLHI(P2)
0C03 35                XPAH    P1
0C04 C2EF              LD      LO(P2)            ;WAS THERE AN EXACT MATCH?
0C06 E101              XOR     1(P1)
0C08 9C07              JNZ     $3
0C0A C2EE              LD      HI(P2)
0C0C E100              XOR     0(P1)
0C0E 9C01              JNZ     $3                ;NO - FLAG THE ADDRESS
0C10 3F                XPPC    P3                ;YES - RETURN NORMALLY
0C11 C2F2       $3     LD      LABLHI(P2)        ;SET SIGN BIT OF HIGH PART
0C13 DC80              ORI     080               ; OF ADDRESS TO INDICATE
0C15 CAF2              ST      LABLHI(P2)        ; INEXACT MATCH OF LINE #'S
0C17 3F                XPPC    P3

                       PAGE    'I. L. MACROS'

                ;***********************************
                ;*           I. L. MACROS          *
                ;***********************************

                       LOCAL

     2000       $TSTBIT =      TSTBIT*256
     8000       $CALBIT =      CALBIT*256
     4000       $JMPBIT =      JMPBIT*256

                       MACRO   TST,FAIL,A,B
                       DBYTE   $TSTBIT!FAIL
                       IF      #=2
                       BYTE    'A'!080
                       ELSE
                       ASCII   'A'
                       BYTE    'B'!080
                       ENDIF
                       ENDM

                       MACRO   TSTCR,FAIL
                       DBYTE   $TSTBIT!FAIL
                       BYTE    0D!080
                       ENDM

                       MACRO   TSTV,FAIL
                       ADDR    TSTVAR
                       DBYTE   FAIL
                       ENDM

                       MACRO   TSTN,FAIL
                       ADDR    TSTNUM
                       DBYTE   FAIL
                       ENDM

                       MACRO   JUMP,ADR
                       DBYTE   $JMPBIT!ADR
                       ENDM

                       MACRO   CALL,ADR
                       DBYTE   $CALBIT!ADR
                       ENDM

                       MACRO   DO
                       MLOC    I
                       SET     I,1
                       DO      #
                       ADDR    #I
                       SET     I,I+1
                       ENDDO
                       ENDM
                       PAGE    'I. L. TABLE'

                ;*************************************
                ;*                 I. L. TABLE              *
                ;*******************************************

0C18            START:  DO      NLINE
0C1A            PROMPT: DO      GETL
                        TSTCR   PRMPT1
0C1F                    JUMP    PROMPT
0C21            PRMPT1: TSTN    LIST
0C25                    DO      FNDPGE,XCHGP1,POPAE,FNDLBL,INSRT
0C2F                    JUMP    PROMPT

0C31            LIST:   TST     RUN,'LIS','T'
0C37                    DO      FNDPGE
0C39                    TSTN    LIST1
0C3D                    DO      POPAE,FNDLBL
0C41                    JUMP    LIST2
0C43            LIST1   DO      CHPAGE
0C45            LIST2   DO      LST
0C47            LIST3:  CALL    PRNUM
0C49                    DO      LST3
0C4B                    JUMP    START

0C4D            RUN:    TST     CLR,'RU','N'
0C52                    DO      DONE
0C54            BEGIN   DO      FNDPGE,CHPAGE,STRT,NXT

0C5C            CLR:    TST     NEW,'CLEA','R'
0C63                    DO      DONE,CLEAR,NXT

0C69            NEW     TST     STMT,'NE','W'
0C6E                    TSTN    DFAULT
0C72                    JUMP    NEW1
0C74            DFAULT: DO      LIT1
0C76            NEW1:   DO      DONE,POPAE,NUPAGE,FNDPGE,NEWPGM,NXT

0C82            STMT    TST     LET,'LE','T'
0C87            LET:    TSTV    AT
0C8B                    TST     SYNTAX,'='
0C8E                    CALL    RELEXP
0C90                    DO      STORE,DONE,NXT
0C96            AT:     TST     IF,'@'
0C99                    CALL    FACTOR
0C9B                    TST     SYNTAX,'='
0C9E                    CALL    RELEXP
0CA0                    DO      MOVE,DONE,NXT

0CA6            IF:     TST     UNT,'I','F'
0CAA                    CALL    RELEXP
0CAC                    TST     IF1,'THE','N'
0CB2            IF1:    DO      POPAE,CMPR
0CB6                    JUMP    STMT

0CB8            UNT:    TST     DO,'UNTI','L'
0CBF                    DO      CKMODE
0CC1                    CALL    RELEXP
0CC3                    DO      DONE,POPAE,UNTIL,DETPGE,NXT

0CCD            DO      TST     GOTO,'D','O'
0CD1                    DO      CKMODE,DONE,SAVEDO,NXT

0CD9            GOTO    TST     RETURN,'G','O'
0CDD                    TST     GOSUB,'T','O'
0CE1                    CALL    RELEXP
0CE3                    DO      DONE
0CE5                    JUMP    GO1
0CE7            GOSUB:  TST     SYNTAX,'SU','B'
0CEC                    CALL    RELEXP
0CEE                    DO      DONE,SAV
0CF2            GO1:    DO      FNDPGE,POPAE,FNDLBL,XFER,NXT

0CFC            RETURN: TST     NEXT,'RETUR','N'
0D04                    DO      DONE,RSTR,DETPGE,NXT

0D0C            NEXT:   TST     FOR,'NEX','T'
```

```
0D12                DO      CKMODE
0D14                TSTV    SYNTAX
0D18                DO      DONE, NEXTV
0D1C                CALL    GTROP
0D1E                DO      POPAE, NEXTV1, DETPGE, NXT

0D26      FOR:      TST     STAT, 'FO', 'R'
0D2B                DO      CKMODE
0D2D                TSTV    SYNTAX
0D31                TST     SYNTAX, '='
0D34                CALL    RELEXP
0D36                TST     SYNTAX, 'T', 'O'
0D3A                CALL    RELEXP
0D3C                TST     FOR1, 'STE', 'P'
0D42                CALL    RELEXP
0D44                JUMP    FOR2
0D46      FOR1:     DO      LIT1
0D48      FOR2:     DO      DONE, SAVFOR, STORE, NXT

0D50      STAT:     TST     PGE, 'STA', 'T'
0D56                TST     SYNTAX, '='
0D59                CALL    RELEXP
0D5B                DO      POPAE, MOVESR
0D5F                DO      DONE, NXT

0D63      PGE:      TST     DOLLAR, 'PAG', 'E'
0D69                TST     SYNTAX, '='
0D6C                CALL    RELEXP
0D6E                DO      DONE, POPAE, NUPAGE, FNDPGE, CHPAGE, NXT

0D7A      DOLLAR:   TST     PRINT, '$'
0D7D                CALL    FACTOR
0D7F                TST     SYNTAX, '='
0D82                TST     DOLR1, '"'
0D85                DO      POPAE, PUTSTR
0D89                JUMP    DOLR2
0D8B      DOLR1:    TST     SYNTAX, '$'
0D8E                CALL    FACTOR
0D90                DO      XCHGP1, MOVSTR, XCHGP1
0D96      DOLR2:    DO      DONE, NXT

0D9A      PRINT:    TST     INPUT, 'P', 'R'
0D9E                TST     PR1, 'IN', 'T'
0DA3      PR1:      TST     PR2, '"'
0DA6                DO      PRS
0DA8                JUMP    COMMA
0DAA      PR2:      TST     PR3, '$'
0DAD                CALL    FACTOR
0DAF                DO      XCHGP1, POPAE, PSTRNG, XCHGP1
0DB7                JUMP    COMMA
0DB9      PR3:      CALL    RELEXP
0DBB                CALL    PRNUM
0DBD      COMMA:    TST     PR4, ','
0DC0                JUMP    PR1
0DC2      PR4:      TST     PR5, ';'
0DC5                JUMP    PR6
0DC7      PR5:      DO      NLINE
0DC9      PR6:      DO      DONE, NXT

0DCD      INPUT:    TST     END, 'INPU', 'T'
0DD4                DO      CKMODE
0DD6                TSTV    IN2
0DDA                DO      XCHGP1, GETL
0DDE      IN1:      CALL    RELEXP
0DE0                DO      STORE, XCHGP1
0DE4                TST     IN3, ','
0DE7                TSTV    SYNTAX
0DEB                DO      XCHGP1
0DED                TST     SYNTAX, ','
0DF0                JUMP    IN1
0DF2      IN2:      TST     SYNTAX, '$'
0DF5                CALL    FACTOR
0DF7                DO      XCHGP1, GETL, POPAE, ISTRNG, XCHGP1
0E01      IN3:      DO      DONE, NXT
```

```
2403
2404 0E05          END:    TST      ML,'EN','D'
2405 0E0A                  DO       DONE,BREAK
2406
2407 0E0E          ML:     TST      REM,'LIN','K'
2408 0E14                  CALL     RELEXP
2409 0E16                  DO       DONE,XCHGP1,POPAE,CALLML,XCHGP1,NXT
2410
2411 0E22          REM:    TST      SYNTAX,'RE','M'
2412 0E27                  DO       IGNORE,NXT
2413
2414 0E2B          SYNTAX: DO       ERR
2415 0E2D          ERRNUM: CALL     PRNUM
2416 0E2F                  DO       FIN
2417
2418               ; NOTE. EACH RELATIONAL OPERATOR (EQ, LEQ, ETC.) DOES AN
2419               ; AUTOMATIC 'RTN' (THIS SAVES VALUABE BYTES!)
2420
2421 0E31          RELEXP: CALL     EXPR
2422 0E33                  TST      REL1,'='
2423 0E36                  CALL     EXPR
2424 0E38                  DO       EQ
2425 0E3A          REL1:   TST      REL4,'<'
2426 0E3D                  TST      REL2,'='
2427 0E40                  CALL     EXPR
2428 0E42                  DO       LEQ
2429 0E44          REL2:   TST      REL3,'>'
2430 0E47                  CALL     EXPR
2431 0E49                  DO       NEQ
2432 0E4B          REL3:   CALL     EXPR
2433 0E4D                  DO       LSS
2434 0E4F          REL4:   TST      RETEXP,'>'
2435 0E52                  TST      REL5,'='
2436 0E55                  CALL     EXPR
2437 0E57                  DO       GEQ
2438 0E59          REL5:   CALL     EXPR
2439 0E5B          GTROP:  DO       GTR
2440
2441 0E5D          EXPR:   TST      EX1,'-'
2442 0E60                  CALL     TERM
2443 0E62                  DO       NEG
2444 0E64                  JUMP     EX3
2445 0E66          EX1:    TST      EX2,'+'
2446 0E69          EX2:    CALL     TERM
2447 0E6B          EX3:    TST      EX4,'+'
2448 0E6E                  CALL     TERM
2449 0E70                  DO       ADD
2450 0E72                  JUMP     EX3
2451 0E74          EX4:    TST      EX5,'-'
2452 0E77                  CALL     TERM
2453 0E79                  DO       SUB
2454 0E7B                  JUMP     EX3
2455 0E7D          EX5:    TST      RETEXP,'O','R'
2456 0E81                  CALL     TERM
2457 0E83                  DO       OROP
2458 0E85                  JUMP     EX3
2459 0E87          RETEXP: DO       RTN
2460
2461 0E89          TERM:   CALL     FACTOR
2462 0E8B          T1:     TST      T2,'*'
2463 0E8E                  CALL     FACTOR
2464 0E90                  DO       MUL
2465 0E92                  JUMP     T1
2466 0E94          T2:     TST      T3,'/'
2467 0E97                  CALL     FACTOR
2468 0E99                  DO       DIV
2469 0E9B                  JUMP     T1
2470 0E9D          T3:     TST      RETEXP,'AN','D'
2471 0EA2                  CALL     FACTOR
2472 0EA4                  DO       ANDOP
2473 0EA6                  JUMP     T1
2474
2475 0EA8          FACTOR: TSTV     F1
```

```
0EAC                 DO      IND,RTN
0EB0         F1:     TSTN    F2
0EB4                 DO      RTN
0EB6         F2:     TST     F3,'#'
0EB9                 DO      HEX,RTN
0EBD         F3:     TST     F4,'('
0EC0                 CALL    RELEXP
0EC2                 TST     SYNTAX,')'
0EC5                 DO      RTN
0EC7         F4:     TST     F5,'@'
0ECA                 CALL    FACTOR
0ECC                 DO      EVAL,RTN
0ED0         F5:     TST     F6,'NO','T'
0ED5                 CALL    FACTOR
0ED7                 DO      NOTOP,RTN
0EDB         F6:     TST     F7,'STA','T'
0EE1                 DO      STATUS,RTN
0EE5         F7:     TST     F8,'TO','P'
0EEA                 DO      FNDPGE,TOP,RTN
0EF0         F8:     TST     F9,'MO','D'
0EF5                 CALL    DOUBLE
0EF7                 DO      DIV,MODULO,RTN
0EFD         F9:     TST     F10,'RN','D'
0F02                 CALL    DOUBLE
0F04                 DO      RANDOM,SUB,ADD,DIV,MODULO,ADD,RTN
0F12         F10     TST     SYNTAX,'PAG','E'
0F18                 DO      PUTPGE,RTN

0F1C         DOUBLE: TST     SYNTAX,'('
0F1F                 CALL    RELEXP
0F21                 TST     SYNTAX,','
0F24                 CALL    RELEXP
0F26                 TST     SYNTAX,')'
0F29                 DO      RTN

0F2B         PRNUM:  DO      XCHGP1,PRN
0F2F         PRNUM1: DO      DIV,PRN1,XCHGP1,RTN
                      PAGE   'ERROR MESSAGES'

             ;*************************************
             ;*             ERROR MESSAGES        *
             ;*************************************

                     .MACRO  MESSAGE,A,B
                     .ASCII  'A'
                     .BYTE   'B'!080
                     .ENDM

0F37         MESGS:  MESSAGE ' ERRO','R'       ; 1
0F3D                 MESSAGE 'ARE','A'         ; 2
0F41                 MESSAGE 'STM','T'         ; 3
0F45                 MESSAGE 'CHA','R'         ; 4
0F49                 MESSAGE 'SNT','X'         ; 5
0F4D                 MESSAGE 'VAL','U'         ; 6
0F51                 MESSAGE 'END','"'         ; 7
0F55                 MESSAGE 'NOG','O'         ; 8
0F59                 MESSAGE 'RTR','N'         ; 9
0F5D                 MESSAGE 'NES','T'         ; 10
0F61                 MESSAGE 'NEX','T'         ; 11
0F65                 MESSAGE 'FO','R'          ; 12
0F68                 MESSAGE 'DIV','O'         ; 13
0F6C                 MESSAGE 'BR','K'          ; 14
0F6F                 MESSAGE 'UNT','L'         ; 15
                      PAGE   ' TELETYPE ROUTINES'

             ;*************************************
             ;*     GET CHARACTER AND ECHO IT     *
             ;*************************************
             ;
                     .LOCAL
0F73 C408    GECO:   LDI     8                 ;SET COUNT = 8
0F75 CAEB            ST      NUM(P2)
0F77 06              CSA                       ;SET READER RELAY
```

```
0F78 DC02          ORI     2
0F7A 07            CAS
0F7B 06     $1:    CSA                    ;WAIT FOR START BIT
0F7C D420          ANI     020
0F7E 90FB          JNZ     $1             ;NOT FOUND
0F80 C457          LDI     87             ;DELAY 1/2 BIT TIME
0F82 8F04          DLY     4
0F84 06            CSA                    ;IS START BIT STILL THERE?
0F85 D420          ANI     020
0F87 90F2          JNZ     $1             ;NO
0F89 06            CSA                    ;SEND START BIT
0F8A D4FD          ANI     %2             ;RESET READER RELAY
0F8C DC01          ORI     1
0F8E 07            CAS
0F8F C485   $2:    LDI     133            ;DELAY 1 BIT TIME
0F91 8F08          DLY     8
0F93 06            CSA                    ;GET BIT (SENSEB)
0F94 D420          ANI     020
0F96 9804          JZ      $3
0F98 C401          LDI     1
0F9A 9004          JMP     $4
0F9C C400   $3:    LDI     0
0F9E 9C00          JNZ     $4
0FA0 CAEA   $4:    ST      TEMP(P2)       ;SAVE BIT VALUE (0 OR 1)
0FA2 1F            RRL                    ;ROTATE INTO LINK
0FA3 01            XAE
0FA4 1D            SRL                    ;SHIFT INTO CHARACTER
0FA5 01            XAE                    ;RETURN CHAR TO E
0FA6 06            CSA                    ;ECHO BIT TO OUTPUT
0FA7 DC01          ORI     1
0FA9 E2EA          XOR     TEMP(P2)
0FAB 07            CAS
0FAC BAEB          DLD     NUM(P2)        ;DECREMENT BIT COUNT
0FAE 9CDF          JNZ     $2             ;LOOP UNTIL 0
0FB0 06            CSA                    ;SET STOP BIT
0FB1 D4FE          ANI     0FE
0FB3 07            CAS
0FB4 8F08          DLY     8              ;DELAY APPROX. 2 BIT TIMES
0FB6 40            LDE                    ;AC HAS INPUT CHARACTER
0FB7 D47F          ANI     07F
0FB9 01            XAE
0FBA 40            LDE
0FBB 3F            XPPC    P3             ;RETURN
0FBC 90B5          JMP     GECO

            ;***********************************
            ;*      PRINT CHARACTER AT TTY     *
            ;***********************************

0FBE 01     PUTC:  XAE
0FBF C4FF          LDI     255
0FC1 8F17          DLY     23
0FC3 06            CSA                    ;SET OUTPUT BIT TO LOGIC 0
0FC4 DC01          ORI     1              ; FOR START BIT. (NOTE INVERS
0FC6 07            CAS
0FC7 C409          LDI     9              ;INITIALIZE BIT COUNT
0FC9 CAE8          ST      TEMP3(P2)
0FCB C48A   PUTC1: LDI     138            ;DELAY 1 BIT TIME
0FCD 8F08          DLY     8
0FCF BAE8          DLD     TEMP3(P2)      ;DECREMENT BIT COUNT.
0FD1 9810          JZ      PUTC2
0FD3 40            LDE                    ;PREPARE NEXT BIT
0FD4 D401          ANI     1
0FD6 CAE9          ST      TEMP2(P2)
0FD8 01            XAE                    ;SHIFT DATA RIGHT 1 BIT
0FD9 1C            SR
0FDA 01            XAE
0FDB 06            CSA                    ;SET UP OUTPUT BIT
0FDC DC01          ORI     1
0FDE E2E9          XOR     TEMP2(P2)
0FE0 07            CAS                    ;PUT BIT TO TTY
0FE1 90E8          JMP     PUTC1
0FE3 06     PUTC2: CSA                    ;SET STOP BIT
0FE4 D4FE          ANI     0FE
```

```
2623 0FE6 07             CAS                           ; RETURN
2624 0FE7 3F             XPPC     P3
2625 0FE8 90D4           JMP      PUTC
2626      0000            END     0

TELETYPE ROUTINES

ADD     0335     AESTK   1050     ANDOP   05F0     AT      0C96
BEGIN   0C54     BREAK   0288     CALBIT  0080     CALLML  0963
CHEAT   007C     CHEAT1  009B     CHPAGE  0BBA     CHRNUM  FFE7
CK1     0649     CKMODE  0644     CLEAR   0051     CLEAR1  0056
CLR     0C5C     CMP     0562     CMP1    05C2     CMP2    05CA
CMPR    05D9     COMMA   0DBD     DETPGE  0BC1     DFAULT  0C74
DIV     0410     DO      0CCD     DOLLAR  0D7A     DOLR1   0D8B
DOLR2   0D96     DONE    0135     DONE1   0143     DONE2   0144
DOPTR   FFFF     DOSTAK  107A     DOUBLE  0F1C     E0      0150
E0A     010D     E1      0195     E10     07C6     E11     081E
E12     086D     E12A    08E1     E13     0910     E14     0950
E15     097C     E16     09CC     E16A    0A2E     E17     0A4A
E18     0AA7     E19     0B04     E2      01CC     E3A     028A
E4      02DF     E5      030C     E6      0378     E6A     03D2
E8      064B     E8A     06E5     E8B     06B2     E9      074F
END     0E05     EQ      054C     EREG    FF80     ERR     0223
ERR1    0225     ERR2    0227     ERRNUM  0E2D     EVAL    07E6
EX1     0E66     EX2     0E69     EX3     0E6B     EX4     0E74
EX5     0E7D     EXECIL  0076     EXPR    0E5D     F1      0EB0
F10     0F12     F2      0EB6     F3      0EBD     F4      0EC7
F5      0ED0     F6      0EDB     F7      0EE5     F8      0EF0
F9      0EFD     FACTOR  0EA8     FAIL    05E1     FAILHI  FFEC
FAILLO  FFED     FALSE   05C8     FIN     02B2     FNDLBL  0BDE
FNDPGE  0B94     FOR     0D26     FOR1    0D46     FOR2    0D48
FORPTR  FFFE     FORSTK  108A     GECO    0F73     GEQ     0560
GEQ1    05BE     GETL    0753     GO1     0CF2     GOSUB   0CE7
GOTO    0CD9     GTR     055C     GTR1    05B3     GTROP   0E5B
HEX     0654     HI      FFEE     HILINE  FFF7     IF      0CA6
IF1     0CB2     IGNORE  09B5     ILC1    00AA     ILCALL  00A0
IN1     0DDE     IN2     0DF2     IN3     0E01     IND     0534
INPUT   0DCD     INSRT   0820     ISTRNG  0B22     JMPBIT  0040
LABLHI  FFF2     LABLLO  FFF3     LBUF    10D6     LEQ     0558
LEQ1    05AA     LET     0C87     LIST    0C31     LIST1   0C43
LIST2   0C45     LIST3   0C47     LISTNG  FFF5     LIT1    0A30
LO      FFEF     LOLINE  FFF8     LSS     0554     LSS1    05A2
LST     02E1     LST2    02FF     LST3    030E     LST4    0314
LST5    0324     LSTK    FFFD     MESGS   0F37     ML      0E0E
MODULO  09BC     MOVE    0804     MOVESR  0949     MOVSTR  0B52
MUL     037A     NEG     0363     NEQ     0550     NEQ1    0599
NEW     0C69     NEW1    0C76     NEWPGM  0BCD     NEXT    0D0C
NEXTV   0A85     NEXTV1  0AEA     NLINE   0215     NOJUMP  009D
NOTOP   05F8     NUM     FFEB     NUPAGE  0B89     NXT     028C
NXT1    02A9     OROP    05F4     P1      0001     P1HIGH  FFF0
P1LOW   FFF1     P2      0002     P3      0003     PAGE    FFF6
PCHIGH  FFFA     PCLOW   FFFB     PCSTAK  10A6     PCSTK   FFF9
PGE     0D63     PGM     1120     POPAE   0912     PR1     0DA3
PR2     0DAA     PR3     0DB9     PR4     0DC2     PR5     0DC7
PR6     0DC9     PRINT   0D9A     PRMPT1  0C21     PRN     0197
PRN1    01CE     PRNUM   0F2B     PRNUM1  0F2F     PROMPT  0C1A
PRS     017E     PRS1    0193     PSTRNG  0B06     PUTC    0FBE
PUTC1   0FCB     PUTC2   0FE3     PUTPGE  0B77     PUTSTR  0B32
RANDOM  09CE     REL1    0E3A     REL2    0E44     REL3    0E4B
REL4    0E4F     REL5    0E59     RELEXP  0E31     REM     0E22
RETEXP  0E87     RETURN  0CFC     RNDF    FFE6     RNDX    FFE5
RNDY    FFE4     RSTR    0148     RSTR1   0152     RSTR2   0167
RTN     00FB     RUN     0C4D     RUNMOD  FFF4     SAV     010F
SAV1    012B     SAV2    0131     SAVEDO  0974     SAVFOR  0A42
SBRPTR  FFFC     SBRSTK  106A     SETZ    058D     START   0C18
STAT    0D50     STATUS  0952     STMT    0C82     STORE   04C9
STRT    02C8     SUB     034C     SYNTAX  0E2B     T1      0E8B
T2      0E94     T3      0E9D     TEMP    FFEA     TEMP2   FFE9
TEMP3   FFE8     TERM    0E89     TOP     0990     TST     00C5
TSTBIT  0020     TSTNUM  06B4     TSTVAR  04E9     UNT     0CB8
UNTIL   0924     VARS    101C     X0      00EC     X1      0165
X10     04E2     X11     054A     X12     0597     X12A    05EE
X12B    0637     X12C    067A     X13     06E3     X14     0751
```

```
X15     07B4      X16     07E4      X17     081C      X19     086B
X19A    08E5      X20     0909      X21     094E      X22     098E
X23     09CA      X24     0A2C      X25     0AB3      X26     0AE8
X27     0B30      X4      01CA      X5      0221      X5A     0286
X6      02DD      X6A     030A      X7      034A      X8      0376
X9      03EF      X9A     0439      X9B     04A4      XCHGP1  0639
XFER    0171      XFER1   0179      ZZ0001  101C      ZZ0002  1120
ZZ0003  0FBD      ZZ0004  0FBD      ZZ0005  0FBD      ZZ0006  0FBD
ZZ0007  0F37      ZZ0008  0F37      ZZ0009  0FBD      ZZ000A  10D6
ZZ000B  0FBD      ZZ000C  101C      ZZ000D  0FBD      ZZ000E  0002
ZZ000F  0002      ZZ0010  0006      ZZ0011  0002      ZZ0012  0003
ZZ0013  0002      ZZ0014  0002      ZZ0015  0002      ZZ0016  0002
ZZ0017  0005      ZZ0018  0004      ZZ0019  0002      ZZ001A  0007
ZZ001B  0004      ZZ001C  0004      ZZ001D  0003      ZZ001E  0002
ZZ001F  0006      ZZ0020  0005      ZZ0021  0002      ZZ0022  0003
ZZ0023  0006      ZZ0024  0005      ZZ0025  0002      ZZ0026  0003
ZZ0027  0005      ZZ0028  0002      ZZ0029  0002      ZZ002A  0005
ZZ002B  0003      ZZ002C  0003      ZZ002D  0007      ZZ002E  0003
ZZ002F  0004      ZZ0030  0003      ZZ0031  0002      ZZ0032  0005
ZZ0033  0002      ZZ0034  0003      ZZ0035  0002      ZZ0036  0003
ZZ0037  0003      ZZ0038  0002      ZZ0039  0006      ZZ003A  0003
ZZ003B  0003      ZZ003C  0007      ZZ003D  0003      ZZ003E  0002
ZZ003F  0002      ZZ0040  0002      ZZ0041  0002      ZZ0042  0002
ZZ0043  0002      ZZ0044  0002      ZZ0045  0002      ZZ0046  0002
ZZ0047  0002      ZZ0048  0002      ZZ0049  0002      ZZ004A  0002
ZZ004B  0002      ZZ004C  0002      ZZ004D  0002      ZZ004E  0003
ZZ004F  0002      ZZ0050  0003      ZZ0051  0002      ZZ0052  0003
ZZ0053  0003      ZZ0054  0003      ZZ0055  0004      ZZ0056  0004
ZZ0057  0008      ZZ0058  0003      ZZ0059  0002      ZZ005A  0003
ZZ005B  0005      $0      002A      $0      0420      $0      076F
$0      0996      $0      0B91      $1      0043      $1      01C6
$1      023D      $1      0397      $1      0443      $1      05FA
$1      06E7      $1      0772      $1      0838      $1      0930
$1      097E      $1      099C      $1      09FD      $1      0A4C
$1      0A8F      $1      0B12      $1      0B46      $1      0BA3
$1      0BE4      $1      0F7B      $10     0AA9      $2      01FF
$2      025A      $2      03A8      $2      0454      $2      0707
$2      07B2  *   $2      0842      $2      09A3      $2      0ADD
$2      0B28      $2      0BFC      $2      0F8F      $3      0261
$3      03D4      $3      04AC      $3      084A      $3      0ADF
$3      0C11      $3      0F9C      $4      03F1      $4      0857
$4      0FA0      $5      085E      $ABOR   06C6      $ADD    08E3
$ADD1   08FF      $CALB   8000      $CR     07D8      $DOWN   0885
$END    04C3      $END    06AC      $END    0B4C      $ENT1   04A6
$ENTE   068B      $ENTE   07B6      $EXIT   0402      $FAIL   04FB
$JMPB   4000      $LETR   067C      $LOOP   002C      $LOOP   00DB
$LOOP   0203      $LOOP   0241      $LOOP   03B6      $LOOP   0460
$LOOP   066C      $LOOP   06F7      $LOOP   09D9      $LOOP   0AD1
$LOOP   0B38      $LOOP   0B68      $LOOP   0BAA      $MAYB   050D
$MOVE   086F      $MSG    0247      $NEG    00EE      $NOT    0628
$OK     051A      $OK     0688      $OR     0616      $POS    043B
$PRNT   01EF      $REDO   093C      $REDO   0AF6      $RET    06D6
$RUB    07CE      $SCAN   00C7      $SHIF   0692      $SHIF   0714
$SKIP   0664      $TSTB   2000      $UP     0895      $UP1    08A1
$UP2    08C2      $UP3    08C4      $UP4    08D4      $XH     07C8
$XU     07A6

NO ERROR LINES
SOURCE CHECKSUM = 33FE
INPUT FILE     1 NIBL1127 SRC
```

Chapter 4

The Great Experiment Floppy ROM™ #1 Robert Uiterwyk's 6800 4K BASIC

By William Turner and William Blomgren

The one thing that characterizes the microcomputer industry, is the number of innovations that appear on a daily basis. During the infancy of the industry, *Interface Age* in May of 1977 kept pace with the introduction of portable software; in the form of a plastic record called a Floppy ROM™.

This article is a chronicle of the first Floppy ROM™ with Robert Uiterwyk's 4K BASIC for the 6800. What made this first record significant was that it was the first time major systems software was published in machine readable form, that just about anyone could use. More importantly it opened up an era of cheap software distribution.

WHY "PLATTER BASIC" ON A FLOPPY-ROM™?

This is really a two-part question. First, why BASIC at all? The need for high level software is fairly self-evident, and BASIC will be explained in a second article later in this issue. For now, let's just settle with "Why a Floppy-ROM™ or platter?"

Low cost software distribution is a recurring problem. It just appears that "low cost" and "high reliability" just don't seem to mix. Shipping programs in ROM, at several dollars per copy, is too expensive. All magnetic media cost too much, are fairly bulky, and are fragile. Machine readable print requires a fair amount of hardware.

The bar code reader that we have located costs well over $100. Most people do not have a bar code reader, nor even access to one, but many do have some sort of record player. A conventional record costs a fair amount, and is relatively fragile. The "sound Sheet" or floppy-ROM is low in cost, and best of all, requires little more than a record player and your cassette interface. (Use the card at the end of this book to order the Floppy ROM™.)

What's On The Record?

There are two different sections on the record. First are the test patterns to align your cassette interface. The second section is the software you will want to load into your 6800 based microcomputer. This section of the record includes a binary loader program, and the binary dump of BASIC.

What Will I Need To Use The Record?

A 6800 based microprocessor system is a must. A minimum amount of memory considered should be 6K. In addition, a Kansas City Cassette interface is also a must, and some sort of 300-baud terminal is desirable to check the alignment of your cassette interface. A cassette machine should be used to save BASIC once it gets loaded, because the record will have limited life. Don't rely on it for more than ten or twenty loads because it will wear out. BASIC assumes that MIKBUG is resident in your system, with a scratchpad from A000 to A07F. Patching instructions are provided in an appendix to this article for those systems that do not have MIKBUG and the scratchpad. A separate loader program is also supplied for those without a MIKBUG loader. Several SWTPC 6800 systems have been used by various individuals in verifying the concept behind BASIC on a "Floppy-ROM™," so owners of those systems should not have trouble at all. Last but certainly not least, a 33⅓ RPM turntable.

What Is The "Kansas City Standard?"

The "Kansas City" recording standard was established to allow interchange of data and programs between microcomputer users. It allows great latitude in playback speed, and can be used with almost any cassette machine. "Marks", or logic ones, are represented by a frequency of 2400 Hz, and "spaces", or logic zeros, are represented by 1200 Hz. Data is transferred using the standard UART format, (1 start bit, 1 stop bit) at 300 baud. (Roughly thirty characters per second.) These frequencies were chosen because the 16X clock for the UART can be easily derived from the data being fed into the interface. Speed tolerances of 20- to 30% are acceptable. Figure 1 shows the circuit of the Southwest Technical Products AC-30. It is a fairly simple circuit, which will allow entry of the program into your system. With this circuit, or its equivalent, the program on the "floppy-ROM" may be read.

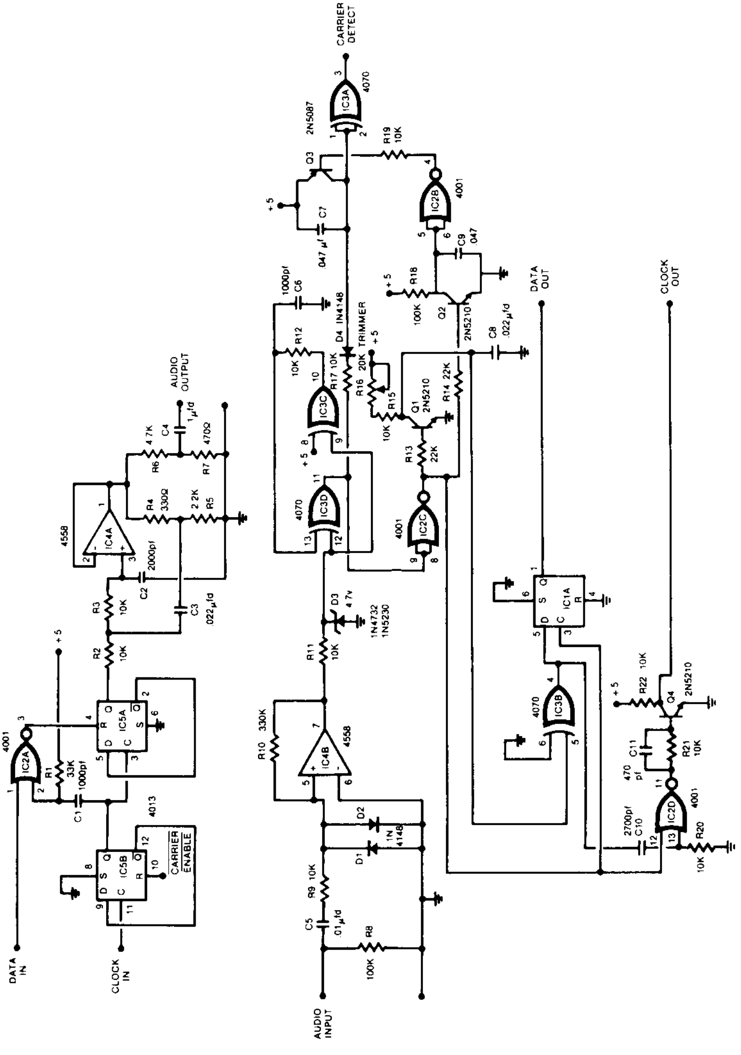


Figure 1. SWTPC AC-30 Cassette Tape Modulator/Demodulator Schematic

How Does It Work?

Audio is fed through the highpass filter made up of R9 and C5. It is clipped by the pair of diodes, and fed into IC-4B, which acts as a comparator. IC-4 should be fed a well regulated 7.5V supply, to ensure stable operation at this point. Zener diode D3 limits the output of IC-4 to levels acceptable to the CMOS gate that follows. When the comparator changes state, IC-3C and IC-3D generate a short (5 microsecond) negative pulse. When data is being received, these pulses repeat. This train of negative pulses grounds C7 through D4. The output of C7 is inverted, buffered, and can be used to generate a carrier detect signal. These negative pulses are found at pin 11 of IC-3D. They're inverted by IC-2A, where they feed four circuits. The first circuit is a missing pulse detector, made up of Q2 and IC-2B. They pull the Carrier detect signal low if several cycles of audio are lost.

The second circuit is an adjustable missing pulse detector, which "times out" when 1200 Hz data are received. R16 trims this time period. The third circuit is flip-flop IC-1A, which outputs the data. Its output is high when 1200 Hz is received. The last circuit is the clock synthesizer, which is made up of IC-2D and IC-3B. These generate the 16X clock for your UART.

How Do I Hook Up A Turntable?

The AC-30 requires about 5 volts of signal to decode the data on the floppy record. Speaker output jacks will easily supply this level. Before you hook up a phonograph, check to see if it has a transformer-isolated chassis. If it doesn't, *don't hook it up!* It would be all too easy to get 120V of your local power utility into your computer. This would tend to make a very expensive pile of write-only memory. If necessary, have a technician check out your stereo. Some component pre-amps are capable of driving 5 volts. A Dyna Pat-4 was used to test the records, and that worked nicely. However, it had to be turned up all the way. If your stereo set has a MONO—STEREO switch, set it on mono. A large percentage of noise on this type of disc is vertical. The vertical signal is essentially a "difference" signal for stereo, but is unwanted for this playback. It will cancel nicely, which will help load a very noisy disc.

Adjust your stereo set for 'flat' response. If your tone control is a 'High Cut' type, set the control for maximum. This is the starting point to align your system. If possible, transcribe the record the first time it is played. It should have reasonable life, 20 to 30 plays or more, but better safe than sorry.

What Are The Weird Signals At The Start Of The Record?

There are two test patterns that should be used to set up your AC-30. The first is a pattern of "5"s. Set your system up to echo the data from the tape to your terminal (local mode). Play back the tape. You should see a stream of "5"s. If you don't, adjust the tone and volume controls slowly and carefully. The "5"s should play back perfectly. There should be no other characters intermixed with the "5"s.

If you are not able to get the "5"s to play back properly, check your interface circuitry next. If you built the interface shown in Figure 1, adjust the R16 to trim the test pattern.

The second test pattern is a "U*" pattern, to check for jitter. If the "5"s worked properly, this should also. If you are not able to get the "5"s to read out, don't go further. Examine your connections, make sure you do not have any ground loops. Make sure you are getting a good clean signal out of the turntable. If you re-recorded the record on a cassette, make sure that you did not overload the cassette recorder when recording. Figure 2, shows a general view of how your system should be hooked up, with the turntable hooked into the AC-30 in place of a cassette machine. If you have arrived this far with flying colors, now is the time to load the program. First check your memory. Make sure all is well before going further.

A slightly high boost may be necessary in some systems. If your system has a rumble filter, switch it on. There will be no valid information below 100 Hz, and elimination of these noise components may be helpful.

If your record player has a good "scratch" filter, try it too. There is no information above 2400, but response at 2400 should be left as "Flat" as possible. If your scratch filter affects 5000 and above, it may be OK; 10000 and above would be better. Remember that most filters have a finite slope and frequencies 2 to 3 octaves away from the break frequency will be affected by level and phase changes. If you detect errors during program load, turn off the 'scratch' filter first.

What If My Turntable Runs Fast Or Slowly?

Again, the beauty of the "Kansas City" standard comes to the rescue. Very few turntables have speed errors larger than 10%, so there is little reason for concern. If your error is very large, adjust your cassette interface card. Run as close to 33⅓ as possible on an adjustable speed turntable.

How To Load The Program

After the test patterns, there is a 20-second space where the 'band' is cut. A string of 'L's follow, to start the loader function in MIKBUG. Place the tone arm down on the record near the end of the test patterns. There is a binary loader program in front of the data, which MIKBUG loads into memory at 1100 HEX. The computer than executes the binary load program, and loads BASIC. Very simple if you have MIKBUG. Figure 4, is a listing of the loader program which was loaded at 1100 HEX. You will note several MIKBUG routines were used. Patch these to fit your operating system. If your turntable has a center depression, place a regular record on the turntable first to support the Floppy-ROM™.

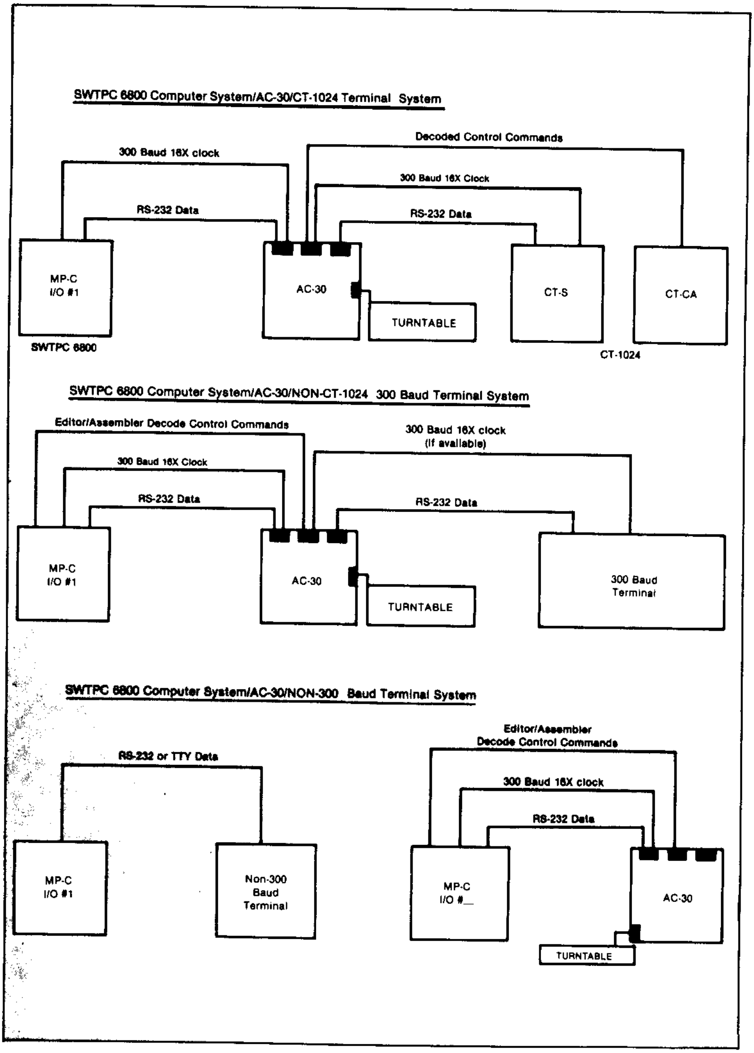


Figure 2. Interconnection Block Diagrams

Pointers And External Routines

Several subroutines in MIKBUG® were used. Copies of these routines may be found in Motorola Engineering Note #100, which is a listing of MIKBUG®. The routines are shown in Listing 1. Here is a short summary of the external subroutines, and a short explanation of what they do.

```
0272  7E E0BF  OUT2H    JMP    $E0BF    OUT2H IN MIKBUG
0275  7E E0C8  OUT4HS   JMP    $E0C8    OUT4HS IN MIKBUG
0278  8D 09    OUTCH    BSR    BREAK
027A  7E E1D1           JMP    $E1D1    OUTEEE IN MIKBUG
027D  BD E1AC  INCH     JSR    $E1AC    INEEE IN MIKBUG
0280  36                PSH A
0281  20 08             BRA    BREAK0
0283  36       BREAK    PSH A
0284  B6 8004           LDA A  $8004
0287  2B 09             BMI    BREAK1
0289  8D F2             BSR    INCH
028B  81 03    BREAK0   CMP A  #$03
028D  26 03             BNE    BREAK1
028F  7E 0815           JMP    READY    NOTE READY LOCATION
0292  32       BREAK1   PUL A
0293  39                RTS             DONE
```

Listing 1.

The first of these routines is "OUT2H." This routine prints the contents of memory pointed to by the index register. The contents are printed as two HEX characters. The index register is incremented before returning. A comparable routine should be found in almost all operating systems. The jump location is:

0272 (HEX): 7E, E0, BF

EOBF is the location of OUT2H in MIKBUG®, 7E is the jump instruction.

The second external routine called is "OUT4HS." This routine will print 4 HEX characters by calling the OUT2H routine twice. It then outputs a space. Again, there is an equivalent in almost all operating systems. This routine returns the Index Register incremented twice. The instruction is located at:

0275: 7E, E0, C8

EOCB is the address of OUT4HS in MIKBUG®.

The input and output routines in MIKBUG® are also used. INEEE and OUTEEE transfer one character through 'A' when called. It should be noted that the control port on a MIKBUG® equipped system is a 'bitbanger' and thus may have different status bits than an ACIA. The jump locations are:

INEEE:

027D: BD, E1, AC (Note it is a jump to subroutine)

OUTEEE:

027A: 7E, E1, D1 (Note that this is a jump)

Listing 1 shows the block of code containing these calls. The listing also has a listing of the break routine. If you are using an ACIA, it will be necessary to change the break routine to check for your status. You will probably have to add a short subroutine to the end of BASIC.

Another not-so-critical patch location is the carriage return-line feed string. The 15(HEX) is the erase to end of line character on a SWTPC CT-1024 terminal. This may be changed as necessary to allow an erase on your terminal. The string is located at:

02AC: 0D, 0A, 15, FF, FF, FF, FF, 1E

If you have to add a routine to the end of BASIC, the pointer for the beginning of program storage must be changed, or BASIC will dramatically change your code! The locations you must change are:

07F9, 07FA

They currently contain 1200 HEX. You would have to change the contents of these locations to point at a location after your routine(s). Any routines that you have to add, should be located beyond 1200.

Stack load and store operating may have to be changed if you don't have memory from A000 to A07F. There are four stack pointer instructions of note. These all load the stack pointer with A045 HEX. These locations are:

080F, 0848, 0B16, 0CC3

There is also a pair of stack references in the patch command routine. The first is at 08F8. This contains A040 currently. The instruction is located in 08FB then stores the stack in A008. Note. . .the "Patch" command has another jump that may have to be changed if you don't have MIKBUG®. 08E3 contains the jump to MIKBUG®. It contains E0E3 currently. Change this to the equivalent in your monitor.

There is an index register stack which has one reference. The index register stack sits at the top of MIKBUG's scratchpad. Location 0819 contains the Value A07F. Move this elsewhere as necessary.

There is a store index register command in the "Patch" routine. It is located at 08F5, and contains an A046. This location is the top of the stack, so the 'G' command will cause a return to BASIC.

Listing 2 shows a possible break routine for those with an ACIA for input. Note that it will not fit in the room that the current break routine occupies. Change the current break to have a jump subroutine at 1200 HEX. A return would follow that.

Listing 3 is a command listing of the biload program. It may be 'patched' to fit into most operating systems, and will be quite easy to implement on a system using an ACIA. The data is transferred through the A accumulator. In MITS 680b systems, you will have to transfer from B to A because they use B for input and output. The place to put your input one character routine call is INCHP. Load your BILOAD equivalent, then execute it. It will ignore the BILOAD program on the FLOPPY ROM™ and load BASIC (hopefully).

```
00001                     NAM     BREAK
00002                     OPT     S,P
00003      0815    READY  EQU     $0815     INSIDE BASIC....
00004      E000    PORT   EQU     $E000
00005 1200                ORG     $1200
00006 1200 36      BREAK  PSH A
00007 1201 B6 E000        LDA A   PORT      (THIS IS THE STATUS PORT)
00008 1204 48             ASL A             PUT DATA AVAILABLE FLAG IN
00009 1205 24 0C          BCC     RETURN    NOTHING THERE..BRANCH
00010 1207 B6 E001        LDA A   PORT+1    BRING IN A CHAR IF THERE
00012 120A 84 7F          AND A   #$7F      GET RID OF PARITY...
00013 120C 81 03          CMP A   #$03      IS IT A BREAK CHARACTER?
00014 120E 26 03          BNE     RETURN    NO...
00015 1210 7E 0815        JMP     READY     YES IT IS!! STOP!
00016              *
00017 1213 32      RETURN PUL A
00018 1214 39             RTS               GO BACK AGAIN...
00019                     END

READY  0815
PORT   E000
BREAK  1200
RETURN 1213
```

Listing 2.

```
00030                          NAM     BILOAD
02780                          OPT     L
02790 19A4 8E 1500 BILOAD LDS     #$1500    NEW STACK LOCATION
02800 19A7 8D 49               BSR     LOAD      GET IO READY
02810 19A9 8D 3C    OVER       BSR     INPUT     GET A CHARACTER
02820 19AB 81 58               CMP A   #'X       IS IT FIRST CHARACTER?
02830 19AD 26 FA               BNE     OVER      IF NOT, KEEP LOOKING.....
02840 19AF 8D 36               BSR     INPUT     GET ANOTHER CHARACTER
02850 19B1 81 31               CMP A   #'1       SECOND CHARACTER?
02860 19B3 27 07               BEQ     READ      GET DATA AND MORE...
02870 19B5 81 39               CMP A   #'9       END CHARACTER?
02880 19B7 26 F0               BNE     OVER      KEEP LOOKING
02890 19B9 7E E0E3             JMP     CONTRL    PATCH HERE FOR OTHER
02895               2895 *                          6800 SYSTEMS

02910 19BC 7F 17FF READ   CLR     CKSM      START WITH ZERO
02920 19BF 8D 26               BSR     INPUT     GET BYTE COUNT
02930 19C1 16                  TAB               PUT IT IN BP
02940 19C2 5C                  INC B   *         INCREMENT IT ONCE
02950 19C3 8D 22               BSR     INPUT     GET FIRST PART OF ADDRESS
02960 19C5 B7 1800             STA A   TW        STORE IT TEMPORARILY
02970 19C8 8D 1D               BSR     INPUT     GET SECOND PART
02980 19CA B7 1801             STA A   TW+1      STORE IT
02990 19CD FE 1800             LDX     TW        PUT IT ALL IN INDEX

03010 19D0 8D 15    STORE      BSR     INPUT     GET SOME DATA
03020 19D2 A7 00               STA A   X         STORE IT
03030 19D4 01                  NOP               TIME TO FORGET..

03050 19D5 A1 00               CMP A   X         IF SAME, GO ON
03060 19D7 26 08               BNE     OUT       IF NOT, NO MEMORY THERE
03070 19D9 08                  INX               POINT AT NEXT LOCATION

03090 19DA 5A                  DEC B   *         SUBTRACT 1 BYTE FROM COUNT
03100 19DB 26 F3               BNE     STORE     NOT DONE, DO MORE
03110 19DD 8D 08               BSR     INPUT     OK, ADD IN TAPE CHECKSUM
03120 19DF 7C 17FF             INC     CKSM      ADD ONE...
03130 19E2 27 C5               BEQ     OVER      IF ZERO, ALL IS GOOD
03140 19E4 7E E040 OUT         JMP     LOAD19    AN ERROR! PRINT GARBAGE
03150 19E7 8D 14    INPUT      BSR     INCHP     INPUT 1-8 BIT CHARACTER
03160 19E9 36                  PSH A   *         SAVE IT
03170 19EA BB 17FF             ADD A   CKSM      ADD SOME TO CHECKSUM
03180 19ED B7 17FF             STA A   CKSM      STORE THE RESULTS
03190 19F0 32                  PUL A   *         RECALL THE DATA
03200 19F1 39                  RTS               GO BACK
```

```
03220 19F2 86 11   LOAD   LDA A  #$11     START YOUR ENGINES
03230 19F4 BD E1D1        JSR    OUTEEE   TELL THE MACHINE TO GO
03240 19F7 86 3C          LDA A  #$3C     PIA READER CONTROL
03250 19F9 B7 8007        STA A  $8007    PUT IT INTO PIA
03260 19FC 39             RTS

03271               3271 * NOTE...IF YOU HAVE A ROUTINE THAT WILL
03272               3272 * INPUT A FULL 8 BIT WORD WITH PARITY
03273               3273 * CALL YOUR ROUTINE IN PLACE OF INCHP...
03274               3274 * FOR EXAMPLE...
03275               3275 *  INCHP PSH B         PROTECT B
03276               3276 *        JSR INCHAR  THIS IS YOUR ROUTINE

03277               3277 *        PUL B         GET B BACK
03278               3278 *        RTS
03279               3279 * PROTECT INDEX REGISTER AT ALL TIMES!!!
03280 19FD 37      INCHP  PSH B  *        THIS IS ALMOST SAME
03290 19FE BD E1A5        JSR    SAV      AS MIKBUG,BUT SAVES PARITY
03300 1A01 A6 00   IN1    LDA A  X        BIT. SEE MOTOROLA ENG.100
03310 1A03 2B FC          BMI    IN1      FOR DETAILS OF HOW IT WORKS


03330 1A05 6F 02          CLR    2,X
03340 1A07 BD E1F3        JSR    DE
03350 1A0A BD E1EF        JSR    DEL
03360 1A0D C6 04          LDA B  #4
03370 1A0F E7 02          STA B  2,X
03380 1A11 58             ASL B

03400 1A12 BD E1EF IN3    JSR    DEL
03410 1A15 0D             SEC
03420 1A16 69 00          ROL    X
03430 1A18 46             ROR A
03440 1A19 5A             DEC B
03450 1A1A 26 F6          BNE    IN3
03460 1A1C BD E1EF        JSR    DEL
03470 1A1F 7E E1E3        JMP    IOUT2
```

Listing 3.

Memory Map for 4K Basic

0000-00FF	Input buffer and temporary variable storage
0100	Hard starting address of BASIC (Cold start—clears program)
0103	Soft starting address of BASIC (warm start—saves program)
0105-10FF	BASIC Interpreter
1100-11FF	Arithmetic and For-Next stack
A000-A045	Machine stack
A04A-A07F	Index register stack

Note: Binary loader program starts at 1100. It will be cleared by the Basic interpreter when 0100 is executed.

```
02775 1100                      ORG    $1100
02780 1100 8E A047 BILOAD LDS    #$A047
02790 1103 8D 49                BSR    LOAD

02800 1105 8D 3C     OVER       BSR    INPUT
02810 1107 81 58                CMP A  #'X
02820 1109 26 FA                BNE    OVER
02830 110B 8D 36                BSR    INPUT
02840 110D 81 31                CMP A  #'1
02850 110F 27 07                BEQ    READ
02860 1111 81 39                CMP A  #'9
```

```
02870 1113 26 F0              BNE      OVER
02880 1115 7E E0E3            JMP      CONTRL


02900 1118 7F A016 READ       CLR      CKSM
02910 111B 8D 26              BSR      INPUT
02920 111D 16                 TAB
02930 111E 5C                 INC B
02940 111F 8D 22              BSR      INPUT
02950 1121 B7 A019            STA A    TW
02960 1124 8D 1D              BSR      INPUT
02970 1126 B7 A01A            STA A    TW+1
02980 1129 FE A019            LDX      TW


03000 112C 8D 15   STORE      BSR      INPUT
03010 112E A7 00              STA A    X
03020 1130 01                 NOP
03040 1131 A1 00              CMP A    X
03050 1133 26 0B              BNE      OUT
03060 1135 08                 INX
03080 1136 5A                 DEC B
03090 1137 26 F3              BNE      STORE
03100 1139 8D 08              BSR      INPUT
03110 113B 7C A016            INC      CKSM
03120 113E 27 C5              BEQ      OVER


03130 1140 7E E040 OUT        JMP      LOAD19

03140 1143 8D 14   INPUT      BSR      INCHP
03150 1145 36                 PSH A
03160 1146 BB A016            ADD A    CKSM
03170 1149 B7 A016            STA A    CKSM
03180 114C 32                 PUL A
03190 114D 39                 RTS


03210 114E 86 11   LOAD       LDA A    #$11
03220 1150 BD E1D1            JSR      OUTEEE
03230 1153 86 3C              LDA A    #$3C
03240 1155 B7 8007            STA A    $8007
03250 1158 39                 RTS
03270 1159 37      INCHP      PSH B
03280 115A BD E1A5            JSR      SAV

03290 115D A6 00   IN1        LDA A    X
03300 115F 2B FC              BMI      IN1
03320 1161 6F 02              CLR      2,X
03330 1163 BD E1F3            JSR      DE
03340 1166 BD E1EF            JSR      DEL
03350 1169 C6 04              LDA B    #4
03360 116B E7 02              STA B    2,X
03370 116D 58                 ASL B


03390 116E BD E1EF IN3        JSR      DEL
03400 1171 0D                 SEC
03410 1172 69 00              ROL      X
03420 1174 46                 ROR A
03430 1175 5A                 DEC B
03440 1176 26 F6              BNE      IN3


03450 1178 BD E1EF            JSR      DEL
03460 117B 7E E1E3            JMP      IOUT2
```

Listing 4.

```
                         NAM  BASIC 4K
                     *
                     *
                     ******* VERSION 2.1 *******
                     *
                     *    BY ROBERT H. UITERWYK
                     *    PLACED IN THE PUBLIC
                     *    DOMAIN    JUNE, 1979 FOR
                     *    THE PURPOSES OF EDUCATION
                     *    FOR ALL MICROCOMPUTER
                     *    USERS.
                     *
                     * THIS PROGRAM ASSUMES THAT THE
                     * MOTOROLA MIKBUG ROM IS INSTALLED
                     * AND THAT ITS ASSOCIATED 128 BYTE
                     * RAM IS ALSO PRESENT
                     * THE SP AND XSTACK WILL HAVE TO
                     * BE MOVED IF THIS IS NOT THE CASE.


00270                *SAVE FIRST $20 BYTES FOR
00280                *FUTURE DISK USE
00290 0020                  ORG    $20
00300 0020 0002      INDEX1 RMB    2
00310 0022 0002      INDEX2 RMB    2
00320 0024 0002      INDEX3 RMB    2
00330 0026 0002      INDEX4 RMB    2
00340 0028 0002      SAVESP RMB    2
00350 002A 0002      NEXTBA RMB    2
00360 002C 0002      WORKBA RMB    2
00370 002E 0002      SOURCE RMB    2
00380                *TO BE CHANGED AT PROGRAMMERS OPTION
00390 0030 0002      PACKLN RMB    2
00400 0032 0002      HIGHLN RMB    2
00410 0034 0002      BASPNT RMB    2
00420 0036 0002      BASLIN RMB    2
00430 0038 0002      PUSHTX RMB    2
00440 003A 0002      XSTACK RMB    2
00450 003C 0002      DATPNT RMB    2
00460 003E 0002      DIMPNT RMB    2
00470 0040 0001      PRCNT  RMB    1
00480 0041 0003             RMB    3
00490 0044 0002      MEMEND RMB    2
00510 0046 0002      ARRTAB RMB    2
00520 0048 0002      KEYWD  RMB    2
00530 004A 0001      TSIGN  RMB    1
00540 004B 0001      EXP    RMB    1
00550 004C 0001      SIGDIG RMB    1
00560 004D 0001      DECFLG RMB    1
00570 004E 0001      TOGGLE RMB    1
00580 004F 0001      NCMPR  RMB    1
00590 0050 0001      TNUMB  RMB    1
00600 0051 0001      ANUMB  RMB    1
00610 0052 0001      BNUMB  RMB    1
00620 0053 0001      LRNINE RMB    1
00630 0054 0001      ROUNDV RMB    1
00640 0055 0001      ONLOOP RMB    1
00650 0056 0001      NORSGN RMB    1
00660 0057 0002      XLONG  RMB    2
00670 0059 0002      MPYXX  RMB    2
00680 005B 0002      BASNUM RMB    2
00690 005D 0002      AESTK  RMB    2
00700 005F 0002      FORPNT RMB    2
00710 0061 0002      FORNOW RMB    2
00720 0063 0002      VARPNT RMB    2
00730 0065 0002      SBRPNT RMB    2
00740 0067 0002      DUMMY  RMB    2
00750 0069 0006      RANNUM RMB    6
00760 006F 0006      FORTMP RMB    6
00770 0075 0010      SBRSTK RMB    16
00780 0085 0001      LOAFLG RMB    1


00800 00AC                  ORG    $00AC
00810 00AC 0002      BUFNXT RMB    2
00820 00AE 0002      ENDBUF RMB    2
00830 00B0                  ORG    $00B0
00840 00B0 0050      BUFFER RMB    $50       I/O BUFFER = 80 DECIMAL
```

```
00860 0100                      ORG     $0100
00870 0100 BD 07F2 PROGM        JSR     START
00880 0103 7E 07F6              JMP     READY
00890 0106 54      INTER        FCC     /TO/
      0107 4F
00900 0108 1F                   FCB     $1F
00910 0109 9999    TOPNT        FDB     $9999
00920 010B 53                   FCC     /STEP/
      010C 54
      010D 45
      010E 50
00930 010F 1F                   FCB     $1F
00940 0110 8888    STEPNT       FDB     $8888
00950 0112 52      COMMAN       FCC     /RUN/
      0113 55
      0114 4E
00960 0115 1F                   FCB     $1F
00970 0116 085B                 FDB     RUN
00980 0118 4C                   FCC     /LIST/
      0119 49
      011A 53
      011B 54
00990 011C 1F                   FCB     $1F
01000 011D 0882                 FDB     CLIST
01010 011F 4E                   FCC     /NEW/
      0120 45
      0121 57
01020 0122 1F                   FCB     $1F
01030 0123 07F2                 FDB     START
01040 0125 50                   FCC     /PAT/
      0126 41
      0127 54
01050 0128 1F                   FCB     $1F
01060 0129 08D3                 FDB     PATCH
01070 012B 4C                   FCC     /LOA/
      012C 4F
      012D 41
01080 012E 1F                   FCB     $1F
01090 012F 090D                 FDB     LOAD
01100 0131 53                   FCC     /SAV/
      0132 41
      0133 56
01110 0134 1F                   FCB     $1F
01120 0135 08E5                 FDB     SAVE
01130 0137 47      GOLIST       FCC     /GOSUB/
      0138 4F
      0139 53
      013A 55
      013B 42
01140 013C 1F                   FCB     $1F
01150 013D 0A5A                 FDB     GOSUB
01160 013F 47                   FCC     /GOTO/
      0140 4F
      0141 54
      0142 4F
01170 0143 1F                   FCB     $1F
01180 0144 0A7C                 FDB     GOTO
01190 0146 4F                   FCC     /ON/
      0147 4E
01200 0148 1F                   FCB     $1F
01210 0149 0A3B                 FDB     ONGO
01220 014B 54                   FCC     /THEN/
      014C 48
      014D 45
      014E 4E
01230 014F 1F                   FCB     $1F
01240 0150 0A29                 FDB     THEN
```

```
01250 0152 50          FCC     /PRINT/
      0153 52
      0154 49
      0155 4E
      0156 54
01260 0157 1F          FCB     $1F
01270 0158 0C6D        FDB     PRINT
01280 015A 4C          FCC     /LET/
      015B 45
      015C 54
01290 015D 1F          FCB     $1F
01300 015E 0DBC        FDB     LET
01310 0160 49          FCC     /INPUT/
      0161 4E
      0162 50
      0163 55
      0164 54
01320 0165 1F          FCB     $1F
01330 0166 0AC4        FDB     INPUT
01340 0168 49          FCC     /IF/
      0169 46
01350 016A 1F          FCB     $1F
01360 016B 0FDD        FDB     IF
01370 016D 52          FCC     /READ/
      016E 45
      016F 41
      0170 44
01380 0171 1F          FCB     $1F
01390 0172 0C17        FDB     READ
01400 0174 44          FCC     /DATA/
      0175 41
      0176 54
      0177 41
01410 0178 1F          FCB     $1F
01420 0179 0DDE        FDB     REMARK
01430 017B 52          FCC     /RESTORE/
      017C 45
      017D 53
      017E 54
      017F 4F
      0180 52
      0181 45
01440 0182 1F          FCB     $1F
01450 0183 0C64        FDB     RESTORE
01460 0185 45          FCC     /END/
      0186 4E
      0187 44
01470 0188 1F          FCB     $1F
01480 0189 07F6        FDB     READY
01490 018B 52          FCC     /RETURN/
      018C 45
      018D 54
      018E 55
      018F 52
      0190 4E
01500 0191 1F          FCB     $1F
01510 0192 0AA2        FDB     RETURN
01520 0194 44          FCC     /DIM/
      0195 49
      0196 4D
01530 0197 1F          FCB     $1F
01540 0198 0F06        FDB     DIM
01550 019A 46          FCC     /FOR/
      019B 4F
      019C 52
01560 019D 1F          FCB     $1F
01570 019E 0F86        FDB     FOR
01580 01A0 4E          FCC     /NEXT/
      01A1 45
      01A2 58
      01A3 54
01590 01A4 1F              FCB    $1F
01600 01A5 0F50            FDB    NEXT
01610 01A7 52              FCC    /REM/
      01A8 45
      01A9 4D
01620 01AA 1F              FCB    $1F
01630 01AB 0DDE            FDB    REMARK
01640 01AD 41              FCC    /APP/
      01AE 50
      01AF 50
01650 01B0 1E              FCB    $1F
01660 01B1 0910            FDB    APPEND
01670 01B3 53       STOMSG FCC    /STOP/
      01B4 54
      01B5 4F
      01B6 50
01680 01B7 1F              FCB    $1F
01690 01B8 0AB6            FDB    STOP
01700 01BA 1F       COMEND FCB    $1F
01710 01BB 0DBC     IMPLET FDB    LET



01730 01BD 52       FUNCT  FCC    /RND(/
      01BE 4F
      01BF 44
      01C0 28
01740 01C1 1F              FCB    $1F
01750 01C2 10B7            FDB    RANDOM
01760 01C4 54              FCC    /TAB(/
      01C5 41
      01C6 42
      01C7 28
01770 01C8 1F              FCB    $1F
01780 01C9 0CB2            FDB    TAB
01790 01CB 49              FCC    /INT(/
      01CC 4F
      01CD 54
      01CE 28
01800 01CF 1F              FCB    $1F
01810 01D0 1079            FDB    INT
01820 01D2 43              FCC    /CHR$(/
      01D3 48
      01D4 52
      01D5 24
      01D6 28
01830 01D7 1F              FCB    $1F
01840 01D8 0CA5            FDB    CHR
01850 01DA 41              FCC    /ABS(/
      01DB 42
      01DC 53
      01DD 28
01860 01DE 1F              FCB    $1F
01870 01DF 10AF            FDB    ABS
01880 01E1 53              FCC    /SGN(/
      01E2 47
      01E3 4F
      01E4 28
01890 01E5 1F              FCB    $1F
01900 01E6 1093            FDB    SGN
01910 01E8 55              FCC    /USER(/
      01E9 53
      01EA 45
      01EB 52
      01EC 28
```

```
01920 01ED 1E       FUNEND FCB     $1E
01930 01EE 106B            FDB     USER
01950 01F0 13       RDYMSG FCB     $13
01960 01F1 14              FCB     $14
01970 01F2 0D              FCB     $0D
01980 01F3 0A              FCB     $0A
01990 01F4 15              FCB     $15
02000 01F5 52              FCC     /READY/
      01F6 45
      01F7 41
      01F8 44
      01F9 59
02010 01FA 1E              FCB     $1E
02020 01FB 20       DELMSG FCC     / DEL/
      01FC 44
      01FD 45
      01FE 4C
02030 01FF 1E              FCB     $1E
02040 0200 10       PGCNTL FCB     $10
02050 0201 16              FCB     $16
02060 0202 1E              FCB     $1E
02070 0203 52       WHAT   FCC     /RE-ENTER/
      0204 45
      0205 2D
      0206 45
      0207 4E
      0208 54
      0209 45
      020A 52
02080 020B 1E              FCB     $1E
02090 020C 45       ERRMS1 FCC     /ERROR# /
      020D 52
      020E 52
      020F 4F
      0210 52
      0211 23
      0212 20
02100 0213 1E              FCB     $1E
02110 0214 20       ERRMS2 FCC     / IN LINE /
      0215 49
      0216 4E
      0217 20
      0218 4C
      0219 49
      021A 4E
      021B 45
      021C 20
02120 021D 1E              FCB     $1E
02140 021F CE 01FB DEL     LDX     #DELMSG
02150 0221 8D 6F           BSR     OUTPUT
02160 0223 20 07           BRA     KEYBD0
02170               *ALL PURPOSE KEYBD ROUTINE
02180 0225 86 3F    KEYBD  LDA A   #$3F      OUTPUT ""
02190 0227 8D 4D           BSR     OUTCH
02200 0229 BD 0350         JSR     PRINSP
02210               *SUBROUTINE ENTRY WITHOUT ""
02220 022C CE 00B0 KEYBD0 LDX      #BUFFER    START OF KEYBD ROUTINE
02230 022F 8D 4A    KEYBD1 BSR     INCH      GET A CHARACTER
02240 0231 81 18           CMP A   #$18
02250 0233 27 E9           BEQ     DEL
02260 0235 81 0D           CMP A   #$0D      IS IT C/R
02270 0237 27 2A           BEQ     IEXIT     IF SO EXIT
02280 0239 81 0F           CMP A   #$0F
02290 023B 26 0C           BNE     *+14
02300 023D 86 5F           LDA A   #$5F
02310 023F 8D 35           BSR     OUTCH
02320 0241 8C 00B0         CPX     #BUFFER    IS IT FIRST CHARACTER
02330 0244 27 F9           BEQ     KEYBD1    IF SO, JUST RELOOP
02340 0246 09              DEX               OTHERWISE, BACKSPACE
```

```
02350 0247 20 F6               BRA      KEYBD1     AND THEN RELOOP
02360 0249 7D 0085             TST      LOAFLG
02370 024C 26 0A               BNE      KEYBD2
02380 024E 8C 00F8             CPX      #BUFFER+72
02390 0251 26 05               BNE      *+7
02400 0253 C6 21               LDA B    #$21
02410 0255 7E 0828             JMP      ERROR
02420 0258 A7 00       KEYBD2  STA A    0,X
02430 025A 08                  INX
02440 025B 20 D2               BRA      KEYBD1
02450 025D 86 23       CNTLIN  LDA A    #'#
02460 025F 8D 15               BSR      OUTCH
02470 0261 20 C9               BRA      KEYBD0
02480 0263 86 1E       IEXIT   LDA A    #$1E
02490 0265 A7 00               STA A    X
02500 0267 DF AE               STX      ENDBUF
02510 0269 96 85               LDA A    LOAFLG
02520 026B 26 02               BNE      *+4
02530 026D 8D 31               BSR      CRLF
02540 026F 39                  RTS


02560                  **********************************************
02570                  *
02580                  *    THIS PAGE CONTAINS EXTERNAL ROUTINE CALLS
02590                  *
02600                  **********************************************
02610 0270 7E E0BF OUT2H   JMP     $E0BF      OUT2H  IN MIKBUG


02630 0273 7E E0C8 OUT4HS  JMP     $E0C8      OUT4HS  IN MIKBUG


02650 0276 8D 09   OUTCH   BSR     BREAK
02660 0278 7E E1D1         JMP     $E1D1      OUTEEE  IN MIKBUG

02680 027B BD E1AC INCH    JSR     $E1AC      INEEE  IN MIKBUG
02690 027E 36              PSH A
02700 027F 20 08           BRA     BREAK0

02720 0281 36      BREAK   PSH A
02730 0282 B6 8004         LDA A   $8004
02740 0285 2B 09           BMI     BREAK1
02750 0287 8D F2           BSR     INCH
02760 0289 81 03   BREAK0  CMP A   #$03
02770 028B 26 03           BNE     BREAK1
02780 028D 7E 07F6         JMP     READY
02790 0290 32      BREAK1  PUL A
02800 0291 39              RTS
02830                  *UNIVERSAL OUTPUT ROUTINE
02840        0292  OUTPUT  EQU     *
02850 0292 8D 05           BSR     OUTNCR
02860 0294 20 0A           BRA     CRLF
02870 0296 8D DE           BSR     OUTCH
02880 0298 08              INX
02890 0299 A6 00   OUTNCR  LDA A   0,X
02900 029B 81 1E           CMP A   #$1E
02910 029D 26 F7           BNE     *-7
02920 029F 39              RTS
02930 02A0 8D 10   CRLF    BSR     PUSHX
02940 02A2 CE 02AA         LDX     #CRLFST
02950 02A5 8D F2           BSR     OUTNCR
02960 02A7 8D 1F           BSR     PULLX
02970 02A9 39              RTS
02980 02AA 0D      CRLFST  FCB     $0D
02990 02AB 0A              FCB     $0A
03000 02AC 15              FCB     $15
03010 02AD FF              FCB     $FF,$FF,$FF,$FF
      02AE FF
      02AF FF
      02B0 FF
03020 02B1 1F          CREND  FCB      $1F


03040 02B2 DF 38       PUSHX  STX      PUSHTX
03050 02B4 DE 3A              LDX      XSTACK
03060 02B6 09                 DEX
03070 02B7 09                 DEX
03080 02B8 DF 3A              STX      XSTACK
03090 02BA 36                 PSH A
03100 02BB 96 38              LDA A    PUSHTX
03110 02BD A7 00              STA A    0,X
03120 02BF 96 39              LDA A    PUSHTX+1
03130 02C1 A7 01              STA A    1,X
03140 02C3 32                 PUL A
03150 02C4 DE 38              LDX      PUSHTX
03160 02C6 39                 RTS


03180 02C7 DE 3A       PULLX  LDX      XSTACK
03190 02C9 EE 00              LDX      0,X
03200 02CB 7C 003B            INC      XSTACK+1
03210 02CE 7C 003B            INC      XSTACK+1
03220 02D1 39                 RTS




03240 02D2 8D DE       STOREX BSR      PUSHX
03250 02D4 BD 0448            JSR      PULLAF
03260 02D7 9F 28              STS      SAVESP
03270 02D9 35                 TXS
03280 02DA DE 3A              LDX      XSTACK
03290 02DC EE 00              LDX      0,X
03300 02DE 20 11              BRA      *+19
03310 02E0 8D D0       STORE  BSR      PUSHX
03320 02E2 BD 0448            JSR      PULLAF
03330 02E5 9F 28              STS      SAVESP
03340 02E7 35                 TXS
03350 02E8 09                 DEX
03360 02E9 09                 DEX
03370 02EA 09                 DEX
03380 02EB 09                 DEX
03390 02EC 09                 DEX
03400 02ED 09                 DEX
03410 02EE 09                 DEX
03420 02EF EE 00              LDX      0,X
03430 02F1 C6 05              LDA B    #5
03440 02F3 32                 PUL A
03450 02F4 A7 00              STA A    0,X
03460 02F6 08                 INX
03470 02F7 5A                 DEC B
03480 02F8 26 F9              BNE      *-5
03490 02FA 32                 PUL A
03500 02FB 32                 PUL A
03510 02FC A7 00              STA A    0,X
03520 02FE 9E 28              LDS      SAVESP
03530 0300 20 C5              BRA      PULLX



03550 0302 8D AE       INDX   BSR      PUSHX
03560 0304 9F 28              STS      SAVESP
03570 0306 35                 TXS
03580 0307 20 0A              BRA      INDO
```

```
03590 0309 8D A7    IND    BSR      PUSHX
03600 030B BD 0448         JSR      PULLAF
03610 030E 9F 28           STS      SAVESP
03620 0310 AE 00           LDS      0,X
03630 0312 34              DES
03640 0313 C6 05    INDO   LDA B    #5
03650 0315 DE 5D           LDX      AESTK
03660 0317 32              PUL  A
03670 0318 A7 00           STA  A   0,X
03680 031A 08              INX
03690 031B 5A              DEC  B
03700 031C 26 F9           BNE      *-5
03710 031E 32              PUL  A
03720 031F A7 01           STA  A   1,X
03730 0321 6F 00           CLR      0,X
03740 0323 9E 28           LDS      SAVESP
03750 0325 BD 043F         JSR      PUSHAE
03760 0328 20 9D           BRA      PULLX



03780 032A BD 0273 OUTLIN JSR      OUT4HS
03790 032D A6 00           LDA  A   0,X
03800 032F 08              INX
03810 0330 BD 02B2         JSR      PUSHX
03820 0333 97 49           STA  A   KEYWD+1
03830 0335 DE 48           LDX      KEYWD
03840 0337 09              DEX
03850 0338 09              DEX
03860 0339 A6 00           LDA  A   0,X
03870 033B 81 1E           CMP  A   #$1E
03880 033D 26 F9           BNE      *-5
03890 033F 08              INX
03900 0340 08              INX
03910 0341 08              INX
03920 0342 BD 0299         JSR      OUTNCR
03930 0345 8D 09           BSR      PRINSP
03940 0347 7F 0040         CLR      PRCNT
03950 034A BD 02C7         JSR      PULLX
03960 034D 7E 0292         JMP      OUTPUT

03980 0350 36       PRINSP PSH  A
03990 0351 86 20           LDA  A   #$20
04000 0353 BD 0CE6         JSR      OUTCHA
04010 0356 32              PUL  A
04020 0357 39              RTS



04040 0358 BD 0744 FINVAR JSR      SKIPSP
04050 035B BD 042A         JSR      TSTLTR
04060 035E 25 26           BCS      FINV11
04070 0360 16       FINV1  TAB
04080 0361 A6 01           LDA  A   1,X
04090 0363 BD 042A         JSR      TSTLTR
04100 0366 25 20           BCS      FINV2
04110 0368 BD 0789         JSR      FCODE
04120 036B BD 02B2         JSR      PUSHX
04130 036E DE 34           LDX      BASPNT
04140 0370 BD 04B1         JSR      PAREXP
04150 0373 DF 34           STX      BASPNT
04160 0375 BD 02C7         JSR      PULLX
```

```
04170 0378 EE 00            LDX     0,X
04180 037A AD 00            JSR     0,X
04190 037C BD 043F          JSR     PUSHAE
04200 037F DE 34            LDX     BASPNT
04210 0381 31               INS                  SINCE FUNCTION CAN ONLY BE
04220 0382 31               INS                  ON RIGHT OF EXPR WE SKIP
04230 0383 31               INS
04240 0384 31               INS                  DIRECTLY FROM TERM
04250 0385 39               RTS
04260 0386 0B       FINV11  SEV
04270 0387 39               RTS
04280 0388 BD 0432  FINV2   JSR     TESTNO
04290 038B 24 07            BCC     FINV3
04300 038D 81 28            CMP A   #'(
04310 038F 27 03            BEQ     FINV3
04320 0391 09               DEX
04330 0392 86 20            LDA A   #$20
04340 0394 08       FINV3   INX
04350 0395 08               INX
04360 0396 BD 02B2          JSR     PUSHX
04370 0399 DE 2A            LDX     NEXTBA
04380 039B 9C 46    FINV4   CPX     ARRTAB
04390 039D 0D               SEC
04400 039E 27 09            BEQ     FINV5
04410 03A0 E1 00            CMP B   0,X
04420 03A2 26 0C            BNE     FINV6
04430 03A4 A1 01            CMP A   1,X
04440 03A6 26 08            BNE     FINV6
04450 03A8 0C               CLC
04460 03A9 DF 63    FINV5   STX     VARPNT
04470 03AB BD 02C7          JSR     PULLX
04480 03AE 0A               CLV
04490 03AF 39               RTS

04510 03B0 36       FINV6   PSH A
04520 03B1 A6 01            LDA A   1,X
04530 03B3 81 28            CMP A   #'(
04540 03B5 32               PUL A
04550 03B6 27 05            BEQ     FINV7
04560 03B8 BD 0457          JSR     INXATE
04570 03BB 20 DE            BRA     FINV4
04580 03BD EE 04    FINV7   LDX     4,X
04590 03BF 20 DA            BRA     FINV4



04610 03C1 BD 0281  TSTV    JSR     BREAK
04620 03C4 8D 92            BSR     FINVAR
04630 03C6 28 01            BVC     TSTV1
04640 03C8 39               RTS
04650 03C9 36       TSTV1   PSH A
04660 03CA 25 31            BCS     TSTV4
04670 03CC DF 34            STX     BASPNT
04680 03CE DE 63            LDX     VARPNT
04690 03D0 81 28            CMP A   #'(
04700 03D2 27 15            BEQ     TSTV3
04710 03D4 08       TSTV11  INX
04720 03D5 08               INX
04730 03D6 DF 63    TSTV2   STX     VARPNT
04740 03D8 DE 5D            LDX     AESTK
04750 03DA 96 63            LDA A   VARPNT
04760 03DC A7 00            STA A   0,X
04770 03DE 96 64            LDA A   VARPNT+1
04780 03E0 A7 01            STA A   1,X
04790 03E2 8D 5A            BSR     PUSHAE
04800 03E4 32               PUL A
04810 03E5 DE 34            LDX     BASPNT
```

```
04820 03E7 0C                  CLC
04830 03E8 39                  RTS
04840 03E9 BD 0DE4 TSTV3       JSR     GETPAR
04850 03EC 24 04               BCC     TSTV33
04860 03EE 8D 77   TSTV31      BSR     FIX
04870 03F0 20 01               BRA     TSTV34
04880 03F2 5F      TSTV33      CLR B
04890 03F3 37      TSTV34      PSH B
04900 03F4 8D 71               BSR     FIX
04910 03F6 17                  TBA
04920 03F7 33                  PUL B
04930 03F8 BD 0F59             JSR     SUBCAL
04940 03FB 20 D9               BRA     TSTV2
04950 03FD DF 34   TSTV4       STX     BASPNT
04960 03FF DE 63               LDX     VARPNT
04970 0401 E7 00               STA B   0,X
04980 0403 A7 01               STA A   1,X
04990 0405 81 28               CMP A   #'(
05000 0407 26 19               BNE     TSTV5
05010 0409 C6 0A               LDA B   #10
05020 040B E7 02               STA B   2,X
05030 040D E7 03               STA B   3,X
05040 040F BD 0DE4             JSR     GETPAR
05050 0412 25 03               BCS     TSTV44
05060 0414 5F                  CLR B
05070 0415 E7 03               STA B   3,X
05080 0417 A6 02   TSTV44      LDA A   2,X
05090 0419 BD 0F41             JSR     DIMCAL
05100 041C 6D 03               TST     3,X
05110 041E 27 D2               BEQ     TSTV33
05120 0420 20 CC               BRA     TSTV31
05130 0422 8D 33   TSTV5       BSR     INXATE
05140 0424 DF 46               STX     ARRTAB
05150 0426 DE 63               LDX     VARPNT
05160 0428 20 AA               BRA     TSTV11
05190 042A 81 41   TSTLTR      CMP A   #$41
05200 042C 2B 0C               BMI     NONO
05210 042E 81 5A               CMP A   #$5A
05220 0430 2F 0A               BLE     YESNO

05240 0432 81 30   TESTNO      CMP A   #$30
05250 0434 2B 04               BMI     NONO
05260 0436 81 39               CMP A   #$39
05270 0438 2F 02               BLE     YESNO
05280 043A 0D      NONO        SEC
05290 043B 39                  RTS
05300 043C 0C      YESNO       CLC
05310 043D 39                  RTS



05330 043E DE 5D   PUSHAE      LDX     AESTK
05340 0440 8D 16               BSR     INXSEV
05350 0442 DF 5D               STX     AESTK
05360 0444 39                  RTS

05380 0445 BD 02B2 PSHXPA      JSR     PUSHX

05400 0448 DE 5D   PULLAE      LDX     AESTK
05410 044A 8D 03               BSR     DEXSEV
05420 044C 20 F4               BRA     *-10

05440 044E 09      DEXATE      DEX
05450 044F 09      DEXSEV      DEX
```

```
05460 0450 09           DEXSIX DEX
05470 0451 09           DEXFIV DEX
05480 0452 09           DEXFOR DEX
05490 0453 09                  DEX
05500 0454 09                  DEX
05510 0455 09                  DEX
05520 0456 39                  RTS

05540 0457 08           INXATE INX
05550 0458 08           INXSEV INX
05560 0459 08           INXSIX INX
05570 045A 08           INXFIV INX
05580 045B 08           INXFOR INX
05590 045C 08                  INX
05600 045D 08                  INX
05610 045E 08                  INX
05620 045F 9C  44       OVRTST CPX      MEMEND
05630 0461 2B  03              BMI      *+5
05640 0463 7E  09FB            JMP      OVERFL
05650 0466 39                  RTS



05670 0467 BD  0445     FIX    JSR      PSHXPA
05680 046A A6  06              LDA A    6,X
05690 046C 81  04              CMP A    #4
05700 046E 2F  05              BLE      *+7
05710 0470 C6  01       FIXERR LDA B    #1
05720 0472 7E  0828            JMP      ERROR
05730 0475 4F                  CLR A
05740 0476 5F                  CLR B
05750 0477 6D  06       FIX2   TST      6,X
05760 0479 2F  19              BLE      FIXEX
05770 047B 58                  ASL B
05780 047C 49                  ROL A
05790 047D D7  52              STA B    BNUMB
05800 047F 97  51              STA A    ANUMB
05810 0481 58                  ASL B
05820 0482 49                  ROL A
05830 0483 58                  ASL B
05840 0484 49                  ROL A
05850 0485 DB  52              ADD B    BNUMB
05860 0487 99  51              ADC A    ANUMB
05870 0489 EB  00              ADD B    0,X
05880 048B 89  00              ADC A    #0
05890 048D BD  0552            JSR      ALLEFT
05900 0490 6A  06              DEC      6,X
05910 0492 20  E3              BRA      FIX2
05920 0494 4D           FIXEX  TST A
05930 0495 26  D9              BNE      FIXERR
05940 0497 7E  02C7            JMP      PULLX



05960 049A BD  0744     FACT   JSR      SKIPSP
05970 049D BD  03C1            JSR      TSTV
05980 04A0 25  04              BCS      *+6
05990 04A2 BD  0309            JSR      IND
06000 04A5 39                  RTS
06010 04A6 BD  0B28            JSR      TSTN
06020 04A9 25  01              BCS      *+3
06030 04AB 39                  RTS
06040 04AC 81  28              CMP A    #'(
06050 04AE 26  11              BNE      FACT3
06060 04B0 08                  INX
06070 04B1 8D 33    PAREXP BSR      EXPR
06080 04B3 BD 0744         JSR      SKIPSP
06090 04B6 81 29           CMP  A   #')
06100 04B8 26 02           BNE      FACT2
06110 04BA 08              INX
06120 04BB 39              RTS
06130 04BC C6 13    FACT2  LDA  B   #$13
06140 04BE 7E 0828         JMP      ERROR
06150 04C1 C6 06    FACT3  LDA  B   #$06
06160 04C3 20 F9           BRA      *-5



06180 04C5 8D D3    TERM   BSR      FACT
06190 04C7 BD 0744  TERM0  JSR      SKIPSP
06200 04CA 81 2A           CMP  A   #'*
06210 04CC 26 0B           BNE      TERM1
06220 04CE 08              INX
06230 04CF BD 0744         JSR      SKIPSP
06240 04D2 8D C6           BSR      FACT
06250 04D4 BD 06D1         JSR      MPY
06260 04D7 20 EE           BRA      TERM0
06270 04D9 81 2F    TERM1  CMP  A   #'/
06280 04DB 26 08           BNE      TERM2
06290 04DD 08              INX
06300 04DE 8D BA           BSR      FACT
06310 04E0 BD 0659         JSR      DIV
06320 04E3 20 E2           BRA      TERM0
06330 04E5 39       TERM2  RTS



06350 04E6 BD 0744  EXPR   JSR      SKIPSP
06360 04E9 81 2D           CMP  A   #'-
06370 04EB 26 07           BNE      *+9
06380 04ED 08              INX
06390 04EE 8D D5           BSR      TERM
06400 04F0 8D 2D           BSR      NEG
06410 04F2 20 07           BRA      EXPR1
06420 04F4 81 2B           CMP  A   #'+
06430 04F6 26 01           BNE      *+3
06440 04F8 08              INX
06450 04F9 8D CA           BSR      TERM
06460 04FB BD 0744  EXPR1  JSR      SKIPSP
06470 04FE 81 2B           CMP  A   #'+
06480 0500 26 08           BNE      *+10
06490 0502 08              INX
06500 0503 8D C0           BSR      TERM
06510 0505 BD 05FC         JSR      ADD
06520 0508 20 F1           BRA      EXPR1
06530 050A 81 2D           CMP  A   #'-
06540 050C 26 08           BNE      *+10
06550 050E 08              INX
06560 050F 8D B4           BSR      TERM
06570 0511 BD 05F9         JSR      SUB
06580 0514 20 E5           BRA      EXPR1
06590 0516 39              RTS



06610 0517 BD 02B2  NEGOP  JSR      PUSHX
06620 051A BD 0458         JSR      INXSEV
06630 051D 20 0C           BRA      *+14
```

```
06640 051F BD 02B2 NEG    JSR    PUSHX
06650 0522 DE 5D          LDX    AESTK
06660 0524 09             DEX
06670 0525 09             DEX
06680 0526 20 06          BRA    *+8
06690 0528 BD 02B2 NEGACC JSR    PUSHX
06700 052B BD 045A        JSR    INXEIV
06710 052E 36             PSH A
06720 052F 37             PSH B
06730 0530 C6 06          LDA B  #6
06740 0532 86 99   NEGA11 LDA A  #$99
06750 0534 A0 00          SUB A  0,X
06760 0536 A7 00          STA A  0,X
06770 0538 09             DEX
06780 0539 5A             DEC B
06790 053A 26 F6          BNE    NEGA11
06800 053C BD 0459        JSR    INXSIX
06810 053F 0D             SEC
06820 0540 C6 06          LDA B  #6
06830 0542 86 00   NEGA2  LDA A  #$00
06840 0544 A9 00          ADC A  0,X
06850 0546 19             DAA
06860 0547 A7 00          STA A  0,X
06870 0549 09             DEX
06880 054A 5A             DEC B
06890 054B 26 F5          BNE    NEGA2
06900 054D 33             PUL B
06910 054E 32             PUL A
06920 054F 7E 02C7        JMP    PULLX



06940 0552 36      ALLEFT PSH A
06950 0553 8D 08          BSR    LLEFT
06960 0555 A6 00          LDA A  0,X
06970 0557 84 0F          AND A  #$0F
06980 0559 A7 00          STA A  0,X
06990 055B 32             PUL A
07000 055C 39             RTS


07020 055D 36      LLEFT  PSH A
07030 055E 37             PSH B
07040 055F DF 57          STX    XLONG
07050 0561 C6 04          LDA B  #4
07060 0563 DE 57   LLEFT2 LDX    XLONG
07070 0565 BD 045A        JSR    INXEIV
07080 0568 68 00          ASL    0,X
07090 056A 86 05          LDA A  #5
07100 056C 09      LLEFT3 DEX
07110 056D 69 00          ROL    0,X
07120 056F 4A             DEC A
07130 0570 26 FA          BNE    LLEFT3
07140 0572 5A             DEC B
07150 0573 26 EE          BNE    LLEFT2
07160 0575 33             PUL B
07170 0576 32             PUL A
07180 0577 39             RTS



07200 0578 36      LRIGHT PSH A
07210 0579 37             PSH B
07220 057A DF 57          STX    XLONG
07230 057C A6 00          LDA A  0,X
```

```
07240 057E 84 F0               AND A   #$F0
07250 0580 97 53               STA A   LRNINF
07260 0582 C6 04               LDA B   #4
07270 0584 DE 57        LRIGH2 LDX     XLONG
07280 0586 64 00               LSR     0,X
07290 0588 86 05               LDA A   #5
07300 058A 08           LRIGH3 INX
07310 058B 66 00               ROR     0,X
07320 058D 4A                  DEC A
07330 058F 26 FA               BNE     LRIGH3
07340 0590 5A                  DEC B
07350 0591 26 F1               BNE     LRIGH2
07360 0593 DE 57               LDX     XLONG
07370 0595 A6 00               LDA A   0,X
07380 0597 9B 53               ADD A   LRNINF
07390 0599 A7 00               STA A   0,X
07400 059B 33                  PUL B
07410 059C 32                  PUL A
07420 059D 39                  RTS



07440 059E BD 043F      NORMPA JSR     PUSHAF

07460 05A1 BD 0445      NORM   JSR     PSHXPA
07470 05A4 7F 0056             CLR     NORSGN
07480 05A7 BD 0DA4             JSR     TSTZER
07490 05AA 24 19               BCC     NORMEZ
07500 05AC A6 00               LDA A   0,X
07510 05AE 2A 0B               BPL     NORM1
07520 05B0 97 56               STA A   NORSGN
07530 05B2 BD 0528             JSR     NEGACC
07540 05B5 86 0F        NORM00 LDA A   #$0F
07550 05B7 A4 00               AND A   0,X
07560 05B9 A7 00               STA A   0,X
07570 05BB A6 00        NORM1  LDA A   0,X
07580 05BD 26 08               BNE     NORMEX
07590 05BF 8D 91               BSR     ALLEFT
07600 05C1 6A 06               DEC     6,X
07610 05C3 20 F6               BRA     NORM1
07620 05C5 6F 06        NORMEZ CLR     6,X
07630 05C7 6F 05        NORMEX CLR     5,X
07640 05C9 A6 06               LDA A   6,X
07650 05CB 81 65               CMP A   #101
07660 05CD 2D 15               BLT     NORME0
07670 05CF 37                  PSH B
07680 05D0 C6 05               LDA B   #5
07690 05D2 86 99               LDA A   #$99
07700 05D4 A7 00        NORM01 STA A   0,X
07710 05D6 08                  INX
07720 05D7 5A                  DEC B
07730 05D8 26 FA               BNE     NORM01
07740 05DA 86 64               LDA A   #100
07750 05DC A7 01               STA A   1,X
07760 05DE BD 0451             JSR     DEXFIV
07770 05E1 33                  PUL B
07780 05E2 20 D1               BRA     NORM00
07790 05E4 81 9D        NORME0 CMP A   #-99
07800 05E6 2E 03               BGT     NORME1
07810 05E8 BD 0BDD             JSR     CLRACC
07820 05EB 7D 0056      NORME1 TST     NORSGN
07830 05EE 27 03               BEQ     NORME2
07840 05F0 BD 0528             JSR     NEGACC
07850 05F3 BD 043F      NORME2 JSR     PUSHAF
07860 05F6 7E 02C7             JMP     PULLX

07880 05F9 BD 051F      SUB    JSR     NEG
```

```
07900 05FC BD 0445 ADD     JSR      PSHXPA
07910 05FF BD 0DA4         JSR      TSTZER
07920 0602 24 25           BCC      ADD4
07930 0604 BD 0578         JSR      LRIGHT
07940 0607 6C 06           INC      6,X
07950 0609 BD 0448         JSR      PULLAE
07960 060C BD 0DA4         JSR      TSTZER
07970 060F 24 11           BCC      ADD1
07980 0611 BD 0578 ADD0    JSR      LRIGHT
07990 0614 6C 06           INC      6,X
08000 0616 A6 06           LDA  A   6,X
08010 0618 A1 0D           CMP  A   13,X
08020 061A 27 08           BEQ      ADD2
08030 061C 2D F3           BLT      ADD0
08040 061E 8D 0C           BSR      SWAP
08050 0620 20 EF           BRA      ADD0
08060 0622 8D 08    ADD1   BSR      SWAP
08070 0624 8D 1F    ADD2   BSR      ADDER
08080 0626 BD 059F         JSR      NORMPA
08090 0629 7E 02C7 ADD4    JMP      PULLX
```

```
08110 062C DE 5D    SWAP   LDX      AESTK
08120 062E 36              PSH  A
08130 062F 37              PSH  B
08140 0630 C6 07           LDA  B   #7
08150 0632 A6 00    SWAP1  LDA  A   0,X
08160 0634 36              PSH  A
08170 0635 A6 07           LDA  A   7,X
08180 0637 A7 00           STA  A   0,X
08190 0639 32              PUL  A
08200 063A A7 07           STA  A   7,X
08210 063C 08              INX
08220 063D 5A              DEC  B
08230 063E 26 F2           BNE      SWAP1
08240 0640 DE 5D    SWAP2  LDX      AESTK
08250 0642 33              PUL  B
08260 0643 32              PUL  A
08270 0644 39              RTS
```

```
08290 0645 36       ADDER  PSH  A
08300 0646 37              PSH  B
08310 0647 DE 5D           LDX      AESTK
08320 0649 C6 06           LDA  B   #6
08330 064B 0C              CLC
08340 064C A6 05    ADDER1 LDA  A   5,X
08350 064E A9 0C           ADC  A   12,X
08360 0650 19              DAA
08370 0651 A7 05           STA  A   5,X
08380 0653 09              DEX
08390 0654 5A              DEC  B
08400 0655 26 F5           BNE      ADDER1
08410 0657 20 E7           BRA      SWAP2
```

```
08430 0659 BD 02B2 DIV     JSR      PUSHX
08440 065C BD 0BDD         JSR      CLRACC
08450 065F BD 0448         JSR      PULLAE
08460 0662 BD 0DA4         JSR      TSTZER
```

```
08470 0665 25 05              BCS      *+7
08480 0667 C6 08              LDA B    #$08
08490 0669 7E 0828            JMP      ERROR
08500 066C 60 06              NEG      6,X
08510 066E 8D 38              BSR      MDSIGN
08520 0670 BD 0578            JSR      LRIGHT
08530 0673 BD 0517            JSR      NEGOP
08540 0676 86 0B              LDA A    #11
08550 0678 5F          DIV2   CLR B
08560 0679 5C          DIV3   INC B
08570 067A 8D C9              BSR      ADDER
08580 067C 6D 00              TST      0,X
08590 067E 2A F9              BPL      DIV3
08600 0680 5A                 DEC B
08610 0681 BD 0517            JSR      NEGOP
08620 0684 8D BF              BSR      ADDER
08630 0686 BD 0517            JSR      NEGOP
08640 0689 BD 0458            JSR      INXSEV
08650 068C BD 0458            JSR      INXSEV
08660 068F BD 055D            JSR      LLEFT
08670 0692 EB 05              ADD B    5,X
08680 0694 E7 05              STA B    5,X
08690 0696 DE 5D              LDX      AESTK
08700 0698 BD 055D            JSR      LLEFT
08710 069B 4A                 DEC A
08720 069C 26 DA              BNE      DIV2
08730 069E BD 043F            JSR      PUSHAE
08740 06A1 8D 89              BSR      SWAP
08750 06A3 7C 0050            INC      TNUMB
08760 06A6 20 56              BRA      MDEXIT
08780 06A8 BD 0578     MDSIGN JSR      LRIGHT
08790 06AB 4F                 CLR A
08800 06AC 6D 00              TST      0,X
08810 06AE 2A 05              BPL      MDS2
08820 06B0 BD 0528            JSR      NEGACC
08830 06B3 86 80              LDA A    #$80
08840 06B5 BD 0448     MDS2   JSR      PULLAE
08850 06B8 6D 00              TST      0,X
08860 06BA 2A 05              BPL      MDS3
08870 06BC BD 0528            JSR      NEGACC
08880 06BF 8B 80              ADD A    #$80
08890 06C1 97 4A       MDS3   STA A    TSIGN
08900 06C3 A6 06              LDA A    6,X
08910 06C5 AB 0D              ADD A    13,X
08920 06C7 28 05              BVC      MDS4
08930 06C9 86 78              LDA A    #120
08940 06CB 24 01              BCC      MDS4
08950 06CD 40                 NEG A
08960 06CE 97 50       MDS4   STA A    TNUMB
08970 06D0 39                 RTS



08990 06D1 BD 0445     MPY    JSR      PSHXPA
09000 06D4 8D D2              BSR      MDSIGN
09010 06D6 DF 59              STX      MPYXX
09020 06D8 BD 043F            JSR      PUSHAE
09030 06DB BD 062C            JSR      SWAP
09040 06DE BD 0BDD            JSR      CLRACC
09050 06E1 86 09              LDA A    #9
09060 06E3 DE 59       MPY4   LDX      MPYXX
09070 06E5 E6 00              LDA B    0,X
09080 06E7 BD 0552            JSR      ALLEFT
09090 06EA 5D          MPY5   TST B
09100 06EB 27 06              BEQ      MPY6
09110 06ED BD 0645            JSR      ADDER
09120 06F0 5A                 DEC B
```

```
09130 06F1 20 F7            BRA      MPY5
09140 06F3 DF 5D    MPY6    LDX      AESTK
09150 06F5 BD 0458          JSR      INXSEV
09160 06F8 BD 0578          JSR      LRIGHT
09170 06FB 4A               DEC A
09180 06FC 26 F5            BNE      MPY4
09190 06FE BD 0448  MDEXIT  JSR      PULLAE
09200 0701 BD 062C          JSR      SWAP
09210 0704 96 50            LDA A    TNUMB
09220 0706 A7 06            STA A    6.X
09230 0708 BD 059F          JSR      NORMPA
09240 070B 7D 004A          TST      TSIGN
09250 070E 2A 03            BPL      MDEX2
09260 0710 BD 051F          JSR      NEG
09270 0713 7E 02C7  MDEX2   JMP      PULLX


09300 0716 96 32    FINDNO  LDA A    HIGHLN
09310 0718 D6 33            LDA B    HIGHLN+
09320 071A D0 31            SUB B    PACKLN+
09330 071C 92 30            SBC A    PACKLN
09340 071E 25 1E            BCS      HIBALL
09350 0720 DE 2E    FINDN1  LDX      SOURCE
09360 0722 96 30    FINDO   LDA A    PACKLN
09370 0724 D6 31            LDA B    PACKLN+
09380 0726 E0 01            SUB B    1.X
09390 0728 A2 00            SBC A    0.X
09400 072A 25 14            BCS      *+22
09410 072C 26 03            BNE      *+5
09420 072E 5D               TST B
09430 072F 27 10            BEQ      *+18
09440 0731 08               INX
09450 0732 08               INX
09460 0733 A6 00            LDA A    0.X
09470 0735 81 1F            CMP A    #$1F
09480 0737 26 F9            BNE      *-5
09490 0739 08               INX
09500 073A 9C 2A            CPX      NEXTBA
09510 073C 26 F4            BNE      FINDO
09520 073E DE 2A    HIBALL  LDX      NEXTBA
09530 0740 0D               SEC
09540 0741 DF 2C            STX      WORKBA
09550 0743 39               RTS


09570 0744 A6 00    SKIPSP  LDA A    0.X
09580 0746 81 20            CMP A    #$20
09590 0748 26 03            BNE      *+5
09600 074A 08       INXSKP  INX
09610 074B 20 F7            BRA      SKIPSP
09620 074D 39               RTS


09640 074E BD 0B28  LINENO  JSR      TSTN
09650 0751 24 05            BCC      *+7
09660 0753 C6 07    LINEO   LDA B    #7
09670 0755 7E 0828          JMP      ERROR
09680 0758 DF AC            STX      BUFNXT
09690 075A BD 0448          JSR      PULLAE
09700 075D E6 06            LDA B    6.X
09710 075F 23 F2            BLS      LINEO
09720 0761 C1 04            CMP B    #4
09730 0763 2E EE            BGT      LINEO
09740 0765 86 05            LDA A    #5
09750 0767 10               SBA
09760 0768 4D               TST A
09770 0769 27 06            BEQ      *+8
09780 076B BD 0578          JSR      LRIGHT
09790 076E 4A               DEC A
```

```
09800 076F 20 F7              BRA      *-7
09810 0771 A6 01              LDA  A   1,X
09820 0773 97 30              STA  A   PACKLN
09830 0775 A6 02              LDA  A   2,X
09840 0777 97 31              STA  A   PACKLN+1
09850 0779 DE AC              LDX      BUFNXT
09860 077B 0C                 CLC
09870 077C 39                 RTS




09890 077D DF 34      NXTLIN  LDX      BASPNT
09900 077F A6 00              LDA  A   0,X
09910 0781 08                 INX
09920 0782 81 1F              CMP  A   #$1F
09930 0784 26 F9              BNE      *-5
09940 0786 DF 36              STX      BASLIN
09950 0788 39                 RTS


09970 0789 DF AC      FCODE   STX      BUFNXT
09980 078B 9F 28              STS      SAVESP
09990 078D CE 01BC            LDX      #FUNCT-1
10000 0790 20 12              BRA      LOOP3


10020 0792 DF AC      CCINT   STX      BUFNXT
10030 0794 9F 28              STS      SAVESP
10040 0796 CE 0105            LDX      #INTER-1
10050 0799 20 09              BRA      LOOP3



10070 079B 8D A7      CCODE   BSR      SKIPSP
10080 079D DF AC              STX      BUFNXT
10090 079F 9F 28              STS      SAVESP
10100 07A1 CE 0111            LDX      #COMMAN-1
10110 07A4 9E AC      LOOP3   LDS      BUFNXT
10120 07A6 34                 DES
10130 07A7 08                 INX
10140 07A8 32                 PUL  A
10150 07A9 81 20              CMP  A   #$20
10160 07AB 27 FB              BEQ      *-3
10170 07AD E6 00              LDA  B   0,X
10180 07AF C1 1F              CMP  B   #$1F
10190 07B1 27 18              BEQ      *+26
10200 07B3 11                 CBA
10210 07B4 27 F1              BEQ      *-13
10220 07B6 08         LOOP5   INX
10230 07B7 8C 01BA            CPX      #COMEND


10240 07BA 27 17              BEQ      CCEXIT
10250 07BC 8C 01ED            CPX      #FUNEND
10260 07BF 27 18              BEQ      FUNCEX
10270 07C1 E6 00              LDA  B   0,X
10280 07C3 C1 1F              CMP  B   #$1F
10290 07C5 26 EF              BNE      LOOP5
10300 07C7 08                 INX
10310 07C8 08                 INX
10320 07C9 20 D9              BRA      LOOP3
10330 07CB 08                 INX
10340 07CC 9F AC              STS      BUFNXT
10350 07CE 9F 34              STS      BASPNT
10360 07D0 9E 28              LDS      SAVESP
10370 07D2 39                 RTS
10380 07D3 9E 28      CCEXIT  LDS      SAVESP
```

```
10390 07D5 CE 01BB        LDX     #IMPLET
10400 07D8 39             RTS
10410 07D9 7E 0B18 FUNCEX JMP     DBLLTR
10440 07DC CE 1200 NEWSUB LDX     #FILE
10450 07DF DF 2F          STX     SOURCE
10460 07E1 DF 2A          STX     NEXTBA
10470 07E3 DF 46          STX     ARRTAB
10480 07E5 4F             CLR A
10490 07E6 97 32          STA A   HIGHLN
10500 07E8 97 33          STA A   HIGHLN+1
10510 07EA 97 40          STA A   PRCNT
10520 07EC CE 1078        LDX     #DUMRTS
10530 07EF DF 67          STX     DUMMY
10540 07F1 39             RTS



10560                     *START OF MAIN PROGRAM
10570                     *
10580                     *
10590 07F2 8D E8   START  BSR     NEWSUB
10600 07F4 20 65          BRA     RUN
10610 07F6 8E A045 READY  LDS     #$A045
10620 07F9 CE A07F        LDX     #$A07F
10630 07FC DF 3A          STX     XSTACK
10640 07FE 7F 0085        CLR     LOAFLG
10650 0801 CE 01F0        LDX     #RDYMSG
10660 0804 BD 0292        JSR     OUTPUT
10670 0807 7F 0040 NEWLIN CLR     PRCNT
10680 080A BD 025D        JSR     CNTLIN
10690 080D CE 0080        LDX     #BUFFER
10700 0810 BD 0744        JSR     SKIPSP
10710 0813 BD 0432        JSR     TESTNO
10720 0816 25 05          BCS     *+7
10730 0818 BD 0949        JSR     NUMBER
10740 081B 20 EA          BRA     NEWLIN
10750 081D 81 1E          CMP A   #$1E
10760 081F 27 E6          BEQ     NEWLIN
10770 0821 BD 079B        JSR     CCODE
10780 0824 EE 00          LDX     0,X
10790 0826 6E 00          JMP     0,X



10810 0828 8E A045 ERROR  LDS     #$A045
10820 082B BD 02A0        JSR     CRLF
10830 082E CE 020C        LDX     #ERRMS1
10840 0831 BD 0299        JSR     OUTNCR
10850 0834 D7 20          STA B   INDEX1
10860 0836 CE 0020        LDX     #INDEX1
10870 0839 BD 0270        JSR     OUT2H
10880 083C CE 0214        LDX     #ERRMS2
10890 083F BD 0299        JSR     OUTNCR
10900 0842 DE 5B          LDX     BASNUM
10910 0844 EE 00          LDX     0,X
10920 0846 DF 30          STX     PACKLN
10930 0848 CE 0030        LDX     #PACKLN
10940 084B 96 34          LDA A   BASPNT
10950 084D 26 04          BNE     *+6
10960 084F 6F 00          CLR     0,X
10970 0851 6F 01          CLR     1,X
10980 0853 BD 0273 ERROR2 JSR     OUT4HS
10990 0856 BD 02A0        JSR     CRLF
11000 0859 20 9B          BRA     READY
```

```
11020 085B DE 2F    RUN     LDX     SOURCE    WITH TEXT BUFFER POINTER
11030 085D DF 3C            STX     DATPNT
11040 085F DF 36            STX     BASLIN
11050 0861 CE 0075          LDX     #SBRSTK
11060 0864 DF 65            STX     SBRPNT
11070 0866 CE 1180          LDX     #FORSTK
11080 0869 DF 5F            STX     FORPNT
11090 086B DE 2A            LDX     NEXTBA
11100 086D DF 46            STX     ARRTAB
11110 086F 4F               CLR A
11120 0870 09               DEX
11130 0871 08               INX
11140 0872 A7 00            STA A   0,X
11150 0874 9C 44            CPX     MEMEND
11160 0876 27 07            BEQ     *+9
11170 0878 A6 00            LDA A   0,X
11180 087A 27 F5            BEQ     *-9
11190 087C 09               DEX
11200 087D DF 44            STX     MEMEND
11210 087F 7E 0A00          JMP     BASIC



11230 0882 CE 0200 CLIST    LDX     #PGCNTL
11240 0885 BD 0292          JSR     OUTPUT
11250 0888 DE 34            LDX     BASPNT
11260 088A BD 0744          JSR     SKIPSP
11270 088D 81 1F            CMP A   #$1F
11280 088F 27 2B            BEQ     CLIST4
11290 0891 BD 074F          JSR     LINENO
11300 0894 DF 34            STX     BASPNT
11310 0896 BD 0720          JSR     FINDN1
11320 0899 DF 24            STX     INDEX3
11330 089B DE 34            LDX     BASPNT
11340 089D BD 0744          JSR     SKIPSP
11350 08A0 81 1F            CMP A   #$1F
11360 08A2 27 04            BEQ     CLIST3
11370 08A4 08               INX
11380 08A5 BD 074F          JSR     LINENO
11390 08A8 4F       CLIST3  CLR A
11400 08A9 C6 01            LDA B   #1
11410 08AB DB 31            ADD B   PACKLN+
11420 08AD 19               DAA
11430 08AE D7 31            STA B   PACKLN+
11440 08B0 99 30            ADC A   PACKLN
11450 08B2 19               DAA
11460 08B3 97 30            STA A   PACKLN
11470 08B5 BD 0720          JSR     FINDN1
11480 08B8 DE 24            LDX     INDEX3
11490 08BA 20 06            BRA     CLIST5
11500 08BC DE 2A    CLIST4  LDX     NEXTBA
11510 08BE DF 2C            STX     WORKBA
11520 08C0 DE 2F            LDX     SOURCE
11530 08C2 9C 2C    CLIST5  CPX     WORKBA
11540 08C4 27 0A            BEQ     CLEXT
11550 08C6 9C 2A            CPX     NEXTBA
11560 08C8 27 06            BEQ     CLEXT
11570 08CA BD 032A          JSR     OUTLIN
11580 08CD 08               INX
11590 08CE 20 F2            BRA     CLIST5
11600 08D0 7E 0DDF CLEXT    JMP     REMARK


11620 08D3 BD 077D PATCH    JSR     NXTLIN
11630 08D6 CE 0A00          LDX     #BASIC
11640 08D9 FF A046          STX     $A046
```

```
11650 08DC 8E A040          LDS      #$A040
11660 08DF BF A008          STS      $A008
11670 08E2 7E F0E3          JMP      $F0E3



11690 08E5 DE 2F    SAVE    LDX      SOURCE
11700 08E7 86 12            LDA A    #$12
11710 08E9 BD 0276          JSR      OUTCH
11720 08EC 8D 45            BSR      DELAY2
11730 08EE 8D 43            BSR      DELAY2
11740 08F0 8D 4C            BSR      LEADER
11750 08F2 9C 2A    SAVE1   CPX      NEXTBA
11760 08F4 27 0D            BEQ      SAVE5
11770 08F6 86 02            LDA A    #$02
11780 08F8 BD 0276          JSR      OUTCH
11790 08FB BD 032A          JSR      OUTLIN
11800 08FE 08               INX
11810 08FF 8D 34            BSR      DELAY
11820 0901 20 EF            BRA      SAVE1
11830 0903 86 03    SAVE5   LDA A    #$03
11840 0905 BD 0276          JSR      OUTCH
11850 0908 8D 34            BSR      LEADER
11860 090A 7E 07F6          JMP      READY



11880 090D BD 07DC  LOAD    JSR      NEWSUB
11890 0910 86 11    APPEND  LDA A    #$11
11900 0912 97 85            STA A    LOAFLG
11910 0914 BD 0276          JSR      OUTCH
11920 0917 BD 027B  LOAD1   JSR      INCH
11930 091A 81 02            CMP A    #$02
11940 091C 26 F9            BNE      LOAD1
11950 091E BD 027B          JSR      INCH
11960. 0921 BD 0432         JSR      TESTNO
11970 0924 25 F4            BCS      LOAD1+3
11980 0926 CE 00B0          LDX      #BUFFER
11990 0929 BD 0231          JSR      KEYBDO+5
12000 092C CE 00B0          LDX      #BUFFER
12010 092F 8D 18            BSR      NUMBER
12020 0931 20 E4            BRA      LOAD1

12040 0933 8D 00    DELAY2  BSR      DELAY

12060 0935 5F       DELAY   CLR B
12070 0936 4F               CLR A
12080 0937 4A       DELAY3  DEC A
12090 0938 26 FD            BNE      DELAY3
12100 093A 5A               DEC B
12110 093B 26 F9            BNE      DELAY+1
12120 093D 39               RTS



12140 093E C6 32    LEADER  LDA B    #50
12150 0940 86 FF            LDA A    #$FF
12160 0942 BD 0276          JSR      OUTCH
12170 0945 5A               DEC B
12180 0946 26 F8            BNE      LEADER+2
12190 0948 39               RTS
```

```
12210 0949 BD 074F NUMBER JSR    LINENO
12220 094C BD 0716 NUM1   JSR    FINDNO
12230 094F 24 13          BCC    DELREP
12240            * YOU HAVE IDENTICAL NUMBER AND U MUST DELETE AND IN
12250 0951 DE AC          LDX    BUFNXT
12260 0953 BD 0744        JSR    SKIPSP
12270 0956 81 1E          CMP A  #$1E
12280 0958 27 21          BEQ    NEXIT
12290 095A DE 2C          LDX    WORKBA
12300 095C 9C 2A          CPX    NEXTBA
12310 095E 27 1C          BEQ    CAPPEN   IF AT END FILE
12320                     * YOU MERELY APPEND
12330                     * OTHERWISE JUST INSERT AND RETURN
12340 0960 8D 48          BSR    INSERT
12350 0962 20 17          BRA    NEXIT
12360 0964 DE AC   DELREP LDX    BUFNXT   GET FIRST CHARACTER
12370 0966 BD 0744        JSR    SKIPSP   AFTER LIN
12380 0969 81 1E          CMP A  #$1E     IS FIRST CHARACTER RS
12390 096B 26 0A          BNE    REPLAC   IF NOT YOU ARE
12400 096D DE 2A          LDX    NEXTBA    REPLACING LINE
12410 096F 9C 2E          CPX    SOURCE
12420 0971 27 08          BEQ    NEXIT
12430 0973 8D 0F          BSR    DELETE   OTHERWISE ONLY DELETE
12440 0975 20 04          BRA    NEXIT    AND RET
12450 0977 8D 0B   REPLAC BSR    DELETE
12460 0979 8D 2F          BSR    INSERT
12470 097B 39      NEXIT  RTS
12480 097C 8D 2C   CAPPEN BSR    INSERT
12490 097E DE 30          LDX    PACKLN   AND MAKE THIS LINE
12500 0980 DF 32          STX    HIGHLN   NEW HIGH L
12510 0982 20 F7          BRA    NEXIT


12530 0984 9F 28   DELETE STS    SAVESP
12540 0986 DE 2C          LDX    WORKBA
12550 0988 9E 2A          LDS    NEXTBA
12560 098A 08             INX
12570 098B 08             INX
12580 098C 34             DES
12590 098D 34             DES
12600 098E A6 00   DEL2   LDA A  0,X
12610 0990 34             DES
12620 0991 08             INX
12630 0992 81 1E          CMP A  #$1E     IF NOT RS,DO IT AGAIN
12640 0994 26 F8          BNE    DEL2
12650 0996 9F 2A          STS    NEXTBA   STACK WAS DECREMENTED
12660 0998 9F 46          STS    ARRTAB   BY # OF
12670 099A 35             TXS
12680 099B DE 2C          LDX    WORKBA
12690 099D 9C 2A   DEL4   CPX    NEXTBA
12700 099F 27 06          BEQ    DELEX
12710 09A1 32             PUL A
12720 09A2 A7 00          STA A  0,X      HONEST 0 OFFSET
12730 09A4 08             INX
12740 09A5 20 F6          BRA    DEL4
12750 09A7 9E 28   DELEX  LDS    SAVESP
12760 09A9 39             RTS



12780 09AA DE AC   INSERT LDX    BUFNXT
12790 09AC BD 079B        JSR    CCODE
12800 09AF 9F 28          STS    SAVESP
12810 09B1 DF 48          STX    KEYWD
12820 09B3 DE 2A          LDX    NEXTBA
12830 09B5 DF 20          STX    INDEX1
12840 09B7 D6 AF          LDA B  ENDBUF+1
```

```
12850 09B9 D0 AD            SUB B   BUFNXT+1
12860 09BB CB 04            ADD B   #$04
12870 09BD DB 2B            ADD B   NEXTBA+1
12880 09BF 86 00            LDA A   #$00
12890 09C1 99 2A            ADC A   NEXTBA
12900 09C3 91 44            CMP A   MEMEND
12910 09C5 22 34            BHI     OVERFL
12920 09C7 D7 2B            STA B   NEXTBA+1
12930 09C9 97 2A            STA A   NEXTBA   THIS INCREMENTS NEXTBA
12940 09CB DF 2A            LDX     NEXTBA   FOR OF
12950 09CD DF 46            STX     ARRTAB
12960 09CF 35               TXS
12970 09D0 DE 20            LDX     INDEX1
12980 09D2 9C 2C      INS2  CPX     WORKBA
12990 09D4 27 06            BEQ     BUFWRT
13000 09D6 09               DEX
13010 09D7 A6 00            LDA A   0,X
13020 09D9 36               PSH A
13030 09DA 20 F6            BRA     INS2
13040 09DC DE 2C      BUFWRT LDX    WORKBA   WE HAVE OPENED HOLE.NOW
13050                 *THE KEYBD BUFFER      CAN I
13060 09DE 96 30            LDA A   PACKLN
13070 09E0 A7 00            STA A   0,X
13080 09E2 08               INX
13090 09E3 96 31            LDA A   PACKLN+1
13100 09E5 A7 00            STA A   0,X
13110 09E7 08               INX
13120 09E8 96 49            LDA A   KEYWD+1
13130 09EA A7 00            STA A   0,X
13140 09EC 08               INX
13150 09ED 9E AC            LDS     BUFNXT
13160 09EF 34               DES
13170 09F0 32               PUL A
13180 09F1 A7 00            STA A   0,X
13190 09F3 08               INX
13200 09F4 81 1F            CMP A   #$1F
13210 09F6 26 F8            BNE     *-6
13220 09F8 9E 28            LDS     SAVESP
13230 09FA 39               RTS
13240 09FB C6 14      OVERFL LDA B  #$14
13250 09FD 7E 0828          JMP     ERROR
```

```
13270 0A00 CE 0112 BASIC    LDX     #COMMAN
13280 0A03 DF 48            STX     KEYWD
13290 0A05 CE 1102          LDX     #ASTACK
13300 0A08 DF 5D            STX     AESTK
13310 0A0A DE 36            LDX     BASLIN
13320 0A0C DF 5B            STX     BASNUM
13330 0A0E 9C 2A            CPX     NEXTBA
13340 0A10 26 03            BNE     *+5
13350 0A12 7E 07F6          JMP     READY
13360 0A15 7D 0036          TST     BASLIN
13370 0A18 27 F8            BEQ     *-6
13380 0A1A 08               INX
13390 0A1B 08               INX
13400 0A1C A6 00            LDA A   0,X
13410 0A1E 08               INX
13420 0A1F DF 34            STX     BASPNT
13430 0A21 97 49            STA A   KEYWD+1
13440 0A23 DE 48            LDX     KEYWD
13450 0A25 EE 00            LDX     0,X
13460 0A27 6E 00            JMP     0,X
```

```
13480 0A29 DE 34    THEN   LDX    BASPNT
13490 0A2B BD 0744         JSR    SKIPSP
13500 0A2E BD 0432         JSR    TESTNO
13510 0A31 24 49           BCC    GOTO
13520 0A33 7E 0FF2         JMP    IF2



13540 0A36 C6 20    ONERR  LDA B  #$20
13550 0A38 7E 0828         JMP    ERROR

13570 0A3B DE 34    ONGO   LDX    BASPNT
13580 0A3D BD 04E6         JSR    EXPR
13590 0A40 BD 0467         JSR    FIX
13600 0A43 5D              TST B
13610 0A44 27 F0           BEQ    ONERR
13620 0A46 5A              DEC B
13630 0A47 D7 55           STA B  ONLOOP
13640 0A49 BD 079B         JSR    CCODE
13650 0A4C EE 00           LDX    0.X
13660 0A4E 8C 0A7C         CPX    #GOTO
13670 0A51 27 2C           BEQ    GOTO+3
13680 0A53 8C 0A5A         CPX    #GOSUB
13690 0A56 27 05           BEQ    GOSUB+3
13700 0A58 20 DC           BRA    ONERR



13720 0A5A 7F 0055 GOSUB   CLR    ONLOOP
13730 0A5D DE 36           LDX    BASLIN
13740 0A5F BD 077D         JSR    NXTLIN
13750 0A62 DE 65           LDX    SBRPNT
13760 0A64 8C 0085         CPX    #SBRSTK+16
13770 0A67 26 05           BNE    GOSUB1
13780 0A69 C6 09           LDA B  #9
13790 0A6B 7E 0828         JMP    ERROR
13800 0A6E 96 36   GOSUB1  LDA A  BASLIN
13810 0A70 A7 00           STA A  0.X
13820 0A72 08              INX
13830 0A73 96 37           LDA A  BASLIN+1
13840 0A75 A7 00           STA A  0.X
13850 0A77 08              INX
13860 0A78 DF 65           STX    SBRPNT
13870 0A7A 20 03           BRA    GOTO+3

13890 0A7C 7F 0055 GOTO    CLR    ONLOOP
13900 0A7F DE 34           LDX    BASPNT
13910 0A81 BD 074F GOTO1   JSR    LINENO
13920 0A84 7A 0055         DEC    ONLOOP
13930 0A87 2B 0A           BMI    *+12
13940 0A89 BD 0744         JSR    SKIPSP
13950 0A8C 81 2C           CMP A  #',
13960 0A8E 26 A6           BNE    ONERR
13970 0A90 08              INX
13980 0A91 20 EE           BRA    GOTO1
13990 0A93 BD 0716         JSR    FINDNO
14000 0A96 24 05           BCC    GOTO2
14010 0A98 C6 07           LDA B  #7
14020 0A9A 7E 0828         JMP    ERROR
14030 0A9D DF 36   GOTO2   STX    BASLIN
14040 0A9F 7E 0A00         JMP    BASIC
```

```
14060 0AA2 DE 65    RETURN LDX     SBRPNT
14070 0AA4 8C 0075         CPX     #SBRSTK
14080 0AA7 26 05           BNE     *+7
14090 0AA9 C6 10           LDA B   #$10
14100 0AAB 7E 0828         JMP     ERROR
14110 0AAE 09              DEX
14120 0AAF 09              DEX
14130 0AB0 DF 65           STX     SBRPNT
14140 0AB2 EE 00           LDX     0,X
14150 0AB4 20 E7           BRA     GOTO2
```

```
14180 0AB6 CE 01B3 STOP    LDX     #STOMSG
14190 0AB9 BD 0299         JSR     OUTNCR
14200 0ABC BD 0350         JSR     PRINSP
14210 0ABF DE 36           LDX     BASLIN
14220 0AC1 7E 0853         JMP     ERROR2
```

```
14240 0AC4 96 34    INPUT  LDA A   BASPNT
14250 0AC6 26 05           BNE     *+7
14260 0AC8 C6 02           LDA B   #2
14270 0ACA 7E 0828 INPERR  JMP     ERROR
14280 0ACD BD 0225         JSR     KEYBD
14290 0AD0 CE 00B0         LDX     #BUFFER
14300 0AD3 DF AC           STX     BUFNXT
14310 0AD5 DE 34           LDX     BASPNT
14320 0AD7 BD 03C1 INPUT1  JSR     TSTV
14330 0ADA 25 31           BCS     INPEX
14340 0ADC DF 34           STX     BASPNT
14350 0ADE DE AC           LDX     BUFNXT
14360 0AE0 8D 3B   INPUT2  BSR     INNUM
14370 0AE2 24 12           BCC     INPUT4
14380 0AE4 81 1E           CMP A   #$1E
14390 0AE6 27 06           BEQ     *+8
14400 0AE8 CE 0203         LDX     #WHAT
14410 0AEB BD 0292         JSR     OUTPUT
14420 0AEE BD 0225         JSR     KEYBD
14430 0AF1 CE 00B0         LDX     #BUFFER
14440 0AF4 20 EA           BRA     INPUT2
14450 0AF6 BD 02E0 INPUT4  JSR     STORE
14460 0AF9 BD 0744         JSR     SKIPSP
14470 0AFC 81 2C           CMP A   #',
14480 0AFE 26 01           BNE     INPUT5
14490 0B00 08              INX
14500 0B01 DF AC   INPUT5  STX     BUFNXT
14510 0B03 DE 34           LDX     BASPNT
14520 0B05 BD 0744         JSR     SKIPSP
14530 0B08 08              INX
14540 0B09 81 2C           CMP A   #',
14550 0B0B 27 CA           BEQ     INPUT1
14560 0B0D 09      INPEX   DEX
14570 0B0E 7F 0040         CLR     PRCNT
14580 0B11 81 1E           CMP A   #$1E
14590 0B13 26 03           BNE     DBLLTR
14600 0B15 7E 0DDE         JMP     REMARK
14610 0B18 C6 03   DBLLTR  LDA B   #3
14620 0B1A 7E 0828         JMP     ERROR
```

```
14650 0B1D BD 0744 INNUM   JSR     SKIPSP
14660 0B20 97 4A           STA A   TSIGN
14670 0B22 08              INX
14680 0B23 81 2D           CMP A   #'-
14690 0B25 27 04           BEQ     INNUM0
14700 0B27 09              DEX


14720 0B28 7F 004A TSTN    CLR     TSIGN
14730 0B2B 4F      INNUM0  CLR A
14740 0B2C 97 4C           STA A   SIGDIG
14750 0B2E 97 4D           STA A   DECFLG
14760 0B30 97 4E           STA A   TOGGLE
14770 0B32 BD 0BDD         JSR     CLRACC
14780 0B35 D6 5D           LDA B   AESTK
14790 0B37 D7 26           STA B   INDEX4
14800 0B39 D6 5E           LDA B   AESTK+1
14810 0B3B D7 27           STA B   INDEX4+1
14820 0B3D C6 05           LDA B   #5
14830 0B3F BD 0744 INTST1  JSR     SKIPSP
14840 0B42 BD 0432         JSR     TESTNO
14850 0B45 24 0B           BCC     INTST2-1
14860 0B47 81 2E           CMP A   #'.
14870 0B49 26 05           BNE     *+7
14880 0B4B 97 4D           STA A   DECFLG
14890 0B4D 08              INX
14900 0B4E 20 EE           BRA     INTST1
14910 0B50 0D              SEC
14920 0B51 39              RTS
14930 0B52 09              DEX
14940 0B53 08      INTST2  INX
14950 0B54 A6 00           LDA A   0,X
14960 0B56 BD 0432         JSR     TESTNO
14970 0B59 25 42           BCS     MAYEXP
14980 0B5B 80 30           SUB A   #$30
14990 0B5D 26 0F           BNE     INTST3
15000 0B5F 7D 004C         TST     SIGDIG
15010 0B62 26 0C           BNE     INTST4
15020 0B64 7D 004D         TST     DECFLG
15030 0B67 27 EA           BEQ     INTST2
15040 0B69 7A 004B         DEC     EXP
15050 0B6C 20 E5           BRA     INTST2
15060 0B6E 97 4C   INTST3  STA A   SIGDIG
15070 0B70 BD 02B2 INTST4  JSR     PUSHX
15080 0B73 DE 26           LDX     INDEX4
15090 0B75 5D              TST B
15100 0B76 27 16           BEQ     INTST6
15110 0B78 7D 004E         TST     TOGGLE
15120 0B7B 26 08           BNE     INTST5
15130 0B7D AB 00           ADD A   0,X
15140 0B7F A7 00           STA A   0,X
15150 0B81 08              INX
15160 0B82 5A              DEC B
15170 0B83 20 06           BRA     INTS55
15180 0B85 48      INTST5  ASL A
15190 0B86 48              ASL A
15200 0B87 48              ASL A
15210 0B88 48              ASL A
15220 0B89 A7 00           STA A   0,X
15230 0B8B 73 004E INTS55  COM     TOGGLE
15240 0B8E DF 26   INTST6  STX     INDEX4
15250 0B90 7D 004D         TST     DECFLG
15260 0B93 26 03           BNE     INTS66
15270 0B95 7C 004B         INC     EXP
15280 0B98 BD 02C7 INTS66  JSR     PULLX
15290 0B9B 20 B6           BRA     INTST2
15300 0B9D 7D 004D MAYEXP  TST     DECFLG
15310 0BA0 26 08           BNE     MAYEX2
15320 0BA2 81 2E           CMP A   #'.
```

```
15330 0BA4 26 04            BNE      MAYEX2
15340 0BA6 97 4D            STA A    DECFLG
15350 0BA8 20 A9            BRA      INTST2
15360 0BAA 5F        MAYEX2 CLR B
15370 0BAB 81 45            CMP A    #'E
15380 0BAD 26 14            BNE      INNEX
15390 0BAF 08               INX
15400 0BB0 A6 00            LDA A    0,X
15410 0BB2 81 2D            CMP A    #'-
15420 0BB4 27 09            BEQ      INTST9
15430 0BB6 81 2B            CMP A    #'+
15440 0BB8 26 01            BNE      INTST8
15450 0BBA 08               INX
15460 0BBB 8D 35     INTST8 BSR      FORMEX
15470 0BBD 20 04            BRA      INNEX
15480 0BBF 08        INTST9 INX
15490 0BC0 8D 30            BSR      FORMEX
15500 0BC2 50               NEG B
15510 0BC3 96 4B     INNEX  LDA A    EXP
15520 0BC5 1B               ABA
15530 0BC6 BD 02B2          JSR      PUSHX
15540 0BC9 DE 5D            LDX      AESTK
15550 0BCB A7 06            STA A    6,X
15560 0BCD BD 043F          JSR      PUSHAE
15570 0BD0 BD 02C7          JSR      PULLX
15580 0BD3 7D 004A          TST      TSIGN
15590 0BD6 27 03            BEQ      *+5
15600 0BD8 BD 051F          JSR      NEG
15610 0BDB 0C               CLC
15620 0BDC 39               RTS

15640 0BDD BD 02B2   CLRACC JSR      PUSHX
15650 0BE0 37               PSH B
15660 0BE1 C6 07            LDA B    #7
15670 0BE3 DE 5D            LDX      AESTK
15680 0BE5 6F 00            CLR      0,X
15690 0BE7 08               INX
15700 0BE8 5A               DEC B
15710 0BE9 26 FA            BNE      *-4
15720 0BEB 7F 004B          CLR      EXP
15730 0BEE 33               PUL B
15740 0BEF 7E 02C7          JMP      PULLX

15760 0BF2 A6 00     FORMEX LDA A    0,X
15770 0BF4 BD 0432          JSR      TESTNO
15780 0BF7 24 05            BCC      *+7
15790 0BF9 C6 02     INNER  LDA B    #2
15800 0BFB 7E 0828          JMP      ERROR
15810 0BFE 80 30            SUB A    #$30
15820 0C00 16               TAB
15830 0C01 08               INX
15840 0C02 A6 00            LDA A    0,X
15850 0C04 BD 0432          JSR      TESTNO
15860 0C07 25 0D            BCS      *+15
15870 0C09 58               ASL B
15880 0C0A 17               TBA
15890 0C0B 58               ASL B
15900 0C0C 58               ASL B
15910 0C0D 1B               ABA
15920 0C0E 16               TAB
15930 0C0F A6 00            LDA A    0,X
15940 0C11 80 30            SUB A    #$30
15950 0C13 1B               ABA
15960 0C14 16               TAB
15970 0C15 08               INX
15980 0C16 39               RTS
```

```
16000 0C17 DE 34    READ    LDX     BASPNT
16010 0C19 BD 03C1  READ1   JSR     TSTV
16020 0C1C 25 3F            BCS     READEX
16030 0C1E DF 34            STX     BASPNT
16040 0C20 DE 3C            LDX     DATPNT
16050 0C22 9C 2F            CPX     SOURCE
16060 0C24 27 1C            BEQ     READ33
16070 0C26 BD 0B1D  READ2   JSR     INNUM
16080 0C29 24 22            BCC     READ4
16090 0C2B 09               DEX
16100 0C2C A6 00            LDA A   0.X
16110 0C2E 81 1E            CMP A   #$1E
16120 0C30 27 05            BEQ     READ3
16130 0C32 C6 19    RDERR   LDA B   #$19
16140 0C34 7E 0828          JMP     ERROR
16150 0C37 9C 2A    READ3   CPX     NEXTRA
16160 0C39 27 F7            BEQ     RDERR
16170 0C3B A6 00            LDA A   0.X
16180 0C3D 08               INX
16190 0C3E 81 1E            CMP A   #$1E
16200 0C40 26 F5            BNE     READ3
16210 0C42 A6 02    READ33  LDA A   2.X
16220 0C44 81 79            CMP A   #$79      VECTOR OF DATA STATEMENT
16230 0C46 26 EF            BNE     READ3
16240 0C48 08               INX
16250 0C49 08               INX
16260 0C4A 08               INX
16270 0C4B 20 D9            BRA     READ2
16280 0C4D BD 02E0  READ4   JSR     STORE
16290 0C50 08               INX
16300 0C51 DF 3C            STX     DATPNT
16310 0C53 DE 34            LDX     BASPNT
16320 0C55 BD 0744          JSR     SKIPSP
16330 0C58 08               INX
16340 0C59 81 2C            CMP A   #',
16350 0C5B 27 BC            BEQ     READ1
16360 0C5D 09       READEX  DEX
16370 0C5E 81 1E            CMP A   #$1E
16380 0C60 26 D0            BNE     RDERR
16390 0C62 20 06            BRA     RESTO1



16410 0C64 DE 2F    RESTOR  LDX     SOURCE
16420 0C66 DF 3C            STX     DATPNT
16430 0C68 DE 34            LDX     BASPNT
16440 0C6A 7E 0DDF  RESTO1  JMP     REMARK



16460 0C6D DE 34    PRINT   LDX     BASPNT
16470 0C6F BD 0744  PRINTO  JSR     SKIPSP
16480 0C72 81 22            CMP A   #'"
16490 0C74 26 14            BNE     PRINT4
16500 0C76 08               INX
16510 0C77 A6 00    PRINT1  LDA A   0.X
16520 0C79 08               INX
16530 0C7A 81 22            CMP A   #'"
16540 0C7C 27 4A            BEQ     PRIN88
16550 0C7E 81 1E            CMP A   #$1E
16560 0C80 26 04            BNE     PRINT2
16570 0C82 C6 04            LDA B   #4
16580 0C84 20 1C            BRA     PRINTE
16590 0C86 8D 6F    PRINT2  BSR     OUTCHA
```

```
16600 0C88 20 FD          BRA    PRINT1
16610 0C8A 81 1F   PRINT4 CMP A  #$1F
16620 0C8C 26 35          BNE    PRINT8
16630 0C8E 09             DEX
16640 0C8F A6 00          LDA A  0,X
16650 0C91 08             INX
16660 0C92 81 3B          CMP A  #';
16670 0C94 27 06          BEQ    PRINT5
16680 0C96 BD 02A0        JSR    CRLF
16690 0C99 7F 0040        CLR    PRCNT
16700 0C9C 08      PRINT5 INX
16710 0C9D DF 36          STX    BASLIN
16720 0C9F 7E 0A00        JMP    BASIC
16730 0CA2 7E 0828 PRINTE JMP    ERROR
16740 0CA5 DE 34   CHR    LDX    BASPNT
16750 0CA7 BD 0467        JSR    FIX
16760 0CAA 17      CHR2   TBA
16770 0CAB 8D 49          BSR    OUTCHA
16780 0CAD 8E A045 PRINT6 LDS    #$A045
16790 0CB0 20 16          BRA    PRIN88
16800 0CB2 DE 34   TAB    LDX    BASPNT
16810 0CB4 BD 0467        JSR    FIX
16820 0CB7 D0 40          SUB B  PRCNT
16830 0CB9 23 F2          BLS    PRINT6
16840 0CBB BD 0350 PRIN77 JSR    PRINSP
16850 0CBE 5A             DEC B
16860 0CBF 26 FA          BNE    PRIN77
16870 0CC1 20 FA          BRA    PRINT6
16880 0CC3 BD 04E6 PRINT8 JSR    EXPR
16890 0CC6 8D 4B          BSR    PRN
16900 0CC8 BD 0744 PRIN88 JSR    SKIPSP
16910 0CCB 81 2C          CMP A  #',
16920 0CCD 26 0E          BNE    PRIN99
16930 0CCF 08             INX
16940 0CD0 96 40   PRLOOP LDA A  PRCNT
16950 0CD2 16             TAB
16960 0CD3 C4 F0          AND B  #$F0
16970 0CD5 10             SBA
16980 0CD6 27 0A          BEQ    PRI999
16990 0CD8 BD 0350        JSR    PRINSP



17010 0CDB 20 F3          BRA    PRLOOP
17020 0CDD 81 3B   PRIN99 CMP A  #';
17030 0CDF 26 04          BNE    PREND
17040 0CE1 08             INX
17050 0CE2 7E 0C6F PRI999 JMP    PRINT0
17060 0CE5 81 1F   PREND  CMP A  #$1F
17070 0CE7 27 A1          BEQ    PRINT4
17080 0CE9 C6 06          LDA B  #6
17090 0CEB 20 B5          BRA    PRINTE



17110 0CED 86 2E   OUTPNT LDA A  #'.
17120 0CEF 20 05          BRA    OUTCHA
17130 0CF1 4F      OUTZER CLR A
17140 0CF2 84 0F   OUTDIG AND A  #$0F
17150 0CF4 8B 30          ADD A  #$30
17160 0CF6 36      OUTCHA PSH A
17170 0CF7 BD 0276        JSR    OUTCH
17180 0CFA 32             PUL A
```

```
17200 0CFB 37         ENLINE PSH B
17210 0CFC D6 40             LDA B  PRCNT
17220 0CFE 5C                INC B
17230 0CFF C1 30             CMP B  #48
17240 0D01 23 0C             BLS    ENLEXT
17250 0D03 C1 3F             CMP B  #63
17260 0D05 27 04             BEQ    *+6
17270 0D07 81 20             CMP A  #$20
17280 0D09 26 04             BNE    ENLEXT
17290 0D0B BD 02A0           JSR    CRLF
17300 0D0E 5F                CLR B
17310 0D0F D7 40      ENLEXT STA B  PRCNT
17320 0D11 33                PUL B
17330 0D12 39                RTS
```

```
17350 0D13 BD 0445 PRN    JSR    PSHXPA
17360 0D16 4F             CLR A
17370 0D17 97 4D          STA A  DECFLG
17380 0D19 6D 00          TST    0.X
17390 0D1B 26 08          BNE    PRN1
17400 0D1D 8D D2          BSR    OUTZER
17410 0D1F BD 02C7 PRN0   JSR    PULLX
17420 0D22 7E 0350        JMP    PRINSP
17430 0D25 6D 00   PRN1   TST    0.X
17440 0D27 2A 07          BPL    PRN2
17450 0D29 86 2D          LDA A  #'-
17460 0D2B 8D C9          BSR    OUTCHA
17470 0D2D BD 0528        JSR    NEGACC
17480 0D30 A6 06   PRN2   LDA A  6.X
17490 0D32 81 09          CMP A  #9
17500 0D34 2F 31          BGT    PRISCI
17510 0D36 81 FF          CMP A  #-1
17520 0D38 2D 2D          BLT    PRISCI
17530 0D3A 4D             TST A
17540 0D3B 2E 10          BGT    PRN4
17550 0D3D 8D B2          BSR    OUTZER
17560 0D3F 8D AC          BSR    OUTPNT
17570 0D41 97 4D          STA A  DECFLG
17580 0D43 6D 06   PRN3   TST    6.X
17590 0D45 2A 1C          BPL    PRN5
17600 0D47 8D A8          BSR    OUTZER
17610 0D49 6C 06          INC    6.X
17620 0D4B 20 F6          BRA    PRN3
17630 0D4D 7D 004D PRN4   TST    DECFLG
17640 0D50 26 11          BNE    PRN5
17650 0D52 A6 00   PRN44  LDA A  0.X
17660 0D54 8D 9C          BSR    OUTDIG
17670 0D56 BD 0552        JSR    ALLEFT
17680 0D59 6A 06          DEC    6.X
17690 0D5B 26 F5          BNE    PRN44
17700 0D5D 8D 45          BSR    TSTZER
17710 0D5F 24 BF          BCC    PRN0
17720 0D61 8D 8A          BSR    OUTPNT
17730 0D63 8D 30   PRN5   BSR    PRTAIL
17740 0D65 20 B8          BRA    PRN0
17750 0D67 A6 00   PRISCI LDA A  0.X
17760 0D69 8D 87          BSR    OUTDIG
17770 0D6B BD 0552        JSR    ALLEFT
17780 0D6E BD 0CED        JSR    OUTPNT
17790 0D71 8D 22          BSR    PRTAIL
17800 0D73 86 45          LDA A  #'E
17810 0D75 BD 0CF6        JSR    OUTCHA
17820 0D78 E6 06          LDA B  6.X
17830 0D7A 5A             DEC B
```

```
17840 0D7B 2A 06             BPL     PRISC2
17850 0D7D 86 2D             LDA A   #'-
17860 0D7F BD 0CF6           JSR     OUTCHA
17870 0D82 50                NEG B
17880 0D83 4F       PRISC2   CLR A
17890 0D84 4C       PRISC3   INC A
17900 0D85 C0 0A             SUB B   #10
17910 0D87 2A FB             BPL     PRISC3
17920 0D89 4A                DEC A
17930 0D8A CB 0A             ADD B   #10
17940 0D8C BD 0CF2           JSR     OUTDIG
17950 0D8F 17                TBA
17960 0D90 BD 0CF2           JSR     OUTDIG
17970 0D93 20 8A             BRA     PRNO

17990 0D95 8D 0D    PRTAIL   BSR     TSTZER
18000 0D97 24 0A             BCC     PRTAEX
18010 0D99 A6 00             LDA A   0,X
18020 0D9B BD 0CF2           JSR     OUTDIG
18030 0D9E BD 0552           JSR     ALLEFT
18040 0DA1 20 F2             BRA     PRTAIL
18050 0DA3 39       PRTAEX   RTS



18070 0DA4 BD 02B2  TSTZER   JSR     PUSHX
18080 0DA7 DE 5D             LDX     AESTK
18090 0DA9 37                PSH B
18100 0DAA C6 06             LDA B   #6
18110 0DAC 6D 00    TSTZ1    TST     0,X
18120 0DAE 26 07             BNE     TSTZ3
18130 0DB0 08                INX
18140 0DB1 5A                DEC B
18150 0DB2 26 F8             BNE     TSTZ1
18160 0DB4 0C                CLC
18170 0DB5 20 01             BRA     TSTZ3+1
18180 0DB7 0D       TSTZ3    SEC
18190 0DB8 33                PUL B
18200 0DB9 7E 02C7           JMP     PULLX

18220 0DBC DE 34    LET      LDX     BASPNT
18230 0DBE BD 03C1           JSR     TSTV
18240 0DC1 24 05             BCC     *+7
18250 0DC3 C6 12    LET0     LDA B   #$12
18260 0DC5 7E 0828  LET00    JMP     ERROR
18270 0DC8 BD 0744           JSR     SKIPSP
18280 0DCB 08                INX
18290 0DCC 81 3D             CMP A   #'=
18300 0DCE 27 04             BEQ     *+6
18310 0DD0 C6 06    LET2     LDA B   #6
18320 0DD2 20 F1             BRA     LET00
18330 0DD4 BD 04F6           JSR     EXPR
18340 0DD7 81 1E             CMP A   #$1E
18350 0DD9 26 F5             BNE     *-9
18360 0DDB BD 02E0           JSR     STORE



18380 0DDE BD 077D  REMARK   JSR     NXTLIN
18390 0DE1 7E 0A00           JMP     BASIC
```

```
18410 0DE4 BD 02B2 GETPAR JSR     PUSHX
18420 0DE7 DE 34          LDX     BASPNT
18430 0DE9 BD 04E6        JSR     EXPR
18440 0DEC 08             INX
18450 0DED 81 2C          CMP  A  #',
18460 0DEF 27 0B          BEQ     GETPA2
18470 0DF1 81 29          CMP  A  #')
18480 0DF3 26 1A          BNE     DIMERR
18490 0DF5 DF 34          STX     BASPNT
18500 0DF7 BD 02C7        JSR     PULLX
18510 0DFA 0C             CLC
18520 0DFB 39             RTS
18530 0DFC BD 04B1 GETPA2 JSR     PAREXP
18540 0DFF DF 34          STX     BASPNT
18550 0E01 BD 02C7        JSR     PULLX
18560 0E04 0D             SEC
18570 0E05 39             RTS
```

```
18590 0E06 DE 34   DIM    LDX     BASPNT
18600 0E08 BD 0358        JSR     FINVAR
18610 0E0B 29 02          BVS     DIMERR
18620 0E0D 25 05          BCS     DIM1
18630 0E0F C6 05   DIMERR LDA  B  #5
18640 0E11 7E 0828        JMP     ERROR
18650 0E14 81 28   DIM1   CMP  A  #'(
18660 0E16 26 F7          BNE     DIMERR
18670 0E18 DF 34          STX     BASPNT
18680 0E1A DE 63          LDX     VARPNT
18690 0E1C E7 00          STA  B  0,X
18700 0E1E A7 01          STA  A  1,X
18710 0E20 8D C2          BSR     GETPAR
18720 0E22 24 05          BCC     DIM3
18730 0E24 BD 0467        JSR     FIX
18740 0E27 20 01          BRA     DIM4
18750 0E29 5F      DIM3   CLR  B
18760 0E2A E7 03   DIM4   STA  B  3,X
18770 0E2C BD 0467        JSR     FIX
18780 0E2F 17             TBA
18790 0E30 A7 02          STA  A  2,X
18800 0E32 8D 0D          BSR     DIMCAL
18810 0E34 DE 34          LDX     BASPNT
18820 0E36 BD 0744        JSR     SKIPSP
18830 0E39 08             INX
18840 0E3A 81 2C          CMP  A  #',
18850 0E3C 27 CA          BEQ     DIM+2
18860 0E3E 09             DEX
18870 0E3F 20 9D          BRA     REMARK
```

```
18890 0E41 BD 02B2 DIMCAL JSR     PUSHX
18900 0E44 E6 03          LDA  B  3,X
18910 0E46 8D 11          BSR     SUBCAL
18920 0E48 BD 0459        JSR     INXSIX
18930 0E4B DF 46          STX     ARRTAB
18940 0E4D BD 02C7        JSR     PULLX
18950 0E50 96 46          LDA  A  ARRTAB
18960 0E52 A7 04          STA  A  4,X
18970 0E54 96 47          LDA  A  ARRTAB+1
18980 0E56 A7 05          STA  A  5,X
18990 0E58 39             RTS
```

```
19010 0E59 4D        SUBCAL TST A
19020 0E5A 26 05            BNE     SUBC1
19030 0E5C C6 15     SUBERR LDA B   #$15
19040 0E5E 7E 0828          JMP     ERROR
19050 0E61 A1 02     SUBC1  CMP A   2.X

19060 0E63 22 F7            BHI     SUBERR
19070 0E65 E1 03            CMP B   3.X
19080 0E67 22 F3            BHI     SUBERR
19090 0E69 36               PSH A
19100 0E6A A6 02            LDA A   2.X
19110 0E6C 97 51            STA A   ANUMB
19120 0E6E 5D               TST B
19130 0E6F 27 0D            BEQ     SUBC6
19140 0E71 5A        SUBC4  DEC B
19150 0E72 27 0A            BEQ     SUBC6
19160 0E74 96 51            LDA A   ANUMB
19170 0E76 BD 0459   SUBC5  JSR     INXSIX
19180 0E79 4A               DEC A
19190 0E7A 26 FA            BNE     SUBC5
19200 0E7C 20 F3            BRA     SUBC4
19210 0E7E 32        SUBC6  PUL A
19220 0E7F BD 0459   SUBC7  JSR     INXSIX
19230 0E82 4A               DEC A
19240 0E83 26 FA            BNE     SUBC7
19250 0E85 39               RTS



19270 0E86 DE 34     FOR    LDX     BASPNT
19280 0E88 BD 03C1          JSR     TSTV
19290 0E8B 24 03            BCC     FOR1
19300 0E8D 7E 0DC3          JMP     LETO        ERROR JUMP
19310 0E90 DF 34     FOR1   STX     BASPNT
19320 0E92 DE 5D            LDX     AESTK
19330 0E94 BD 044F          JSR     DEXSEV
19340 0E97 A6 00            LDA A   0.X
19350 0E99 E6 01            LDA B   1.X
19360 0E9B 97 51            STA A   ANUMB
19370 0E9D D7 52            STA B   BNUMB
19380 0E9F CE 1180          LDX     #FORSTK
19390 0EA2 96 51     FOR10  LDA A   ANUMB
19400 0EA4 D6 52            LDA B   BNUMB
19410 0EA6 9C 5F            CPX     FORPNT
19420 0EA8 27 1C            BEQ     FOR14
19430 0EAA A1 00            CMP A   0.X
19440 0EAC 26 10            BNE     FOR12
19450 0EAE E1 01            CMP B   1.X
19460 0EB0 26 0C            BNE     FOR12
19470 0EB2 96 36            LDA A   BASLIN
19480 0EB4 D6 37            LDA B   BASLIN+1
19490 0EB6 A1 0E            CMP A   14.X
19500 0EB8 26 04            BNE     FOR12
19510 0EBA E1 0F            CMP B   15.X
19520 0EBC 27 08            BEQ     FOR14
19530 0EBE BD 0457   FOR12  JSR     INXATE
19540 0EC1 BD 0457          JSR     INXATE
19550 0EC4 20 DC            BRA     FOR10
19560 0EC6 8C 1200   FOR14  CPX     #FORSTK+128
19570 0EC9 26 05            BNE     FOR11
19580 0ECB C6 10            LDA B   #16
19590 0ECD 7E 0828          JMP     ERROR
19600 0ED0 96 51     FOR11  LDA A   ANUMB
19610 0ED2 D6 52            LDA B   BNUMB
19620 0ED4 A7 00            STA A   0.X
19630 0ED6 08               INX
```

```
19640 0ED7 E7 00            STA B   0,X
19650 0ED9 08               INX
19660 0EDA DF 5F            STX     FORPNT
19670 0EDC DE 34            LDX     BASPNT
19680 0EDE BD 0744          JSR     SKIPSP
19690 0EE1 08               INX
19700 0EE2 81 3D            CMP A   #'=
19710 0EE4 27 03            BEQ     FOR3
19720 0EE6 7E 0DD0  FOR2    JMP     LET2        ERROR JUMP
19730 0EE9 BD 04E6  FOR3    JSR     EXPR
19740 0EEC BD 02F0          JSR     STORE
19750 0EEF BD 0792          JSR     CCINT
19760 0EF2 8C 0109          CPX     #TOPNT
19770 0EF5 26 EF            BNE     FOR2
19780 0EF7 DE 34            LDX     BASPNT
19790 0EF9 BD 04E6          JSR     EXPR
19800 0EFC DF 34            STX     BASPNT
19810 0EFE DE 5F            LDX     FORPNT
19820 0F00 BD 02D2          JSR     STOREX
19830 0F03 BD 0459          JSR     INXSIX
19840 0F06 DF 5F            STX     FORPNT
19850 0F08 DE 34            LDX     BASPNT
19860 0F0A BD 0792          JSR     CCINT
19870 0F0D 8C 0110          CPX     #STEPNT
19880 0F10 26 09            BNE     FOR4
19890 0F12 DE 34            LDX     BASPNT
19900 0F14 BD 04E6          JSR     EXPR
19910 0F17 DF 34            STX     BASPNT
19920 0F19 20 0E            BRA     FOR5
19930 0F1B DE 5D    FOR4    LDX     AESTK
19940 0F1D BD 0BDD          JSR     CLRACC
19950 0F20 86 01            LDA A   #$01
19960 0F22 A7 00            STA A   0,X
19970 0F24 A7 06            STA A   6,X
19980 0F26 BD 043F          JSR     PUSHAE
19990 0F29 DE 5F    FOR5    LDX     FORPNT
20000 0F2B BD 02D2          JSR     STOREX
20010 0F2E BD 0459          JSR     INXSIX
20020 0F31 DF 5F            STX     FORPNT
20030 0F33 DE 34    FOR7    LDX     BASPNT
20040 0F35 BD 0744          JSR     SKIPSP
20050 0F38 81 1E            CMP A   #$1E
20060 0F3A 26 AA    FOR8    BNE     FOR2        ERROR JUMP
20070 0F3C 08               INX
20080 0F3D DF 36            STX     BASLIN
20090 0F3F DE 5F            LDX     FORPNT
20100 0F41 D6 36            LDA B   BASLIN
20110 0F43 E7 00            STA B   0,X
20120 0F45 08               INX
20130 0F46 D6 37            LDA B   BASLIN+1
20140 0F48 E7 00            STA B   0,X
20150 0F4A 08               INX
20160 0F4B DF 5F            STX     FORPNT
20170 0F4D 7E 0A00          JMP     BASIC


20190 0F50 DE 34    NEXT    LDX     BASPNT
20200 0F52 BD 03C1          JSR     TSTV
20210 0F55 24 03            BCC     NEXT1
20220 0F57 7E 0DC3          JMP     LET0        ERROR JUMP
20230 0F5A BD 0744  NEXT1   JSR     SKIPSP
20240 0F5D 81 1E            CMP A   #$1E
20250 0F5F 26 D9            BNE     FOR8        ERROR JUMP
20260 0F61 08               INX
20270 0F62 DF 36            STX     BASLIN
```

```
20280 0F64 BD 0448           JSR    PULLAE
20290 0F67 A6 00             LDA A  0,X
20300 0F69 E6 01             LDA B  1,X
20310 0F6B DE 5F             LDX    FORPNT
20320 0F6D 8C 1180           CPX    #FORSTK
20330 0F70 27 66             BEQ    NEXT6
20340 0F72 DF 5F     NEXT2   STX    FORPNT
20350 0F74 8C 1180           CPX    #FORSTK
20360 0F77 27 5B             BEQ    NEXT5
20370 0F79 BD 044F           JSR    DEXATE
20380 0F7C BD 044F           JSR    DEXATE
20390 0F7F A1 00             CMP A  0,X
20400 0F81 26 EF             BNE    NEXT2
20410 0F83 E1 01             CMP B  1,X
20420 0F85 26 EB             BNE    NEXT2
20430 0F87 DF 61             STX    FORNOW
20440 0F89 EE 00             LDX    0,X
20450 0F8B BD 0302           JSR    INDX
20460 0F8E DE 61             LDX    FORNOW
20470 0F90 BD 0457           JSR    INXATE
20480 0F93 86 02             LDA A  #2
20490 0F95 6D 00             TST    0,X
20500 0F97 2A 02             BPL    *+4
20510 0F99 8B 03             ADD A  #3
20520 0F9B 97 4F             STA A  NCMPR
20530 0F9D BD 0302           JSR    INDX
20540 0FA0 BD 05FC           JSR    ADD
20550 0FA3 CE 006F           LDX    #FORTMP
20560 0FA6 BD 02D2           JSR    STOREX
20570 0FA9 BD 043F           JSR    PUSHAE
20580 0FAC DE 61             LDX    FORNOW
20590 0FAE 08                INX
20600 0FAF 08                INX
20610 0FB0 BD 0302           JSR    INDX
20620 0FB3 BD 1037           JSR    CMPR
20630 0FB6 24 07             BCC    NEXT4
20640 0FB8 DE 61             LDX    FORNOW
20650 0FBA DF 5F             STX    FORPNT
20660 0FBC 7E 0A00   NEXT3   JMP    BASIC
20670 0FBF CE 006F   NEXT4   LDX    #FORTMP
20680 0FC2 BD 0302           JSR    INDX
20690 0FC5 DE 61             LDX    FORNOW
20700 0FC7 EE 00             LDX    0,X
20710 0FC9 BD 02D2           JSR    STOREX
20720 0FCC DE 61             LDX    FORNOW
20730 0FCE EE 0E             LDX    14,X
20740 0FD0 DF 36             STX    BASLIN
20750 0FD2 20 E8             BRA    NEXT3        EXIT
20760 0FD4 C6 18     NEXT5   LDA B  #$18
20770 0FD6 20 02             BRA    NEXT6+2
20780 0FD8 C6 17     NEXT6   LDA B  #$17
20790 0FDA 7E 0828           JMP    ERROR


20810 0FDD DE 34     IF      LDX    BASPNT
20820 0FDF BD 04E6           JSR    EXPR
20830 0FE2 8D 17             BSR    RELOP
20840 0FE4 97 4F             STA A  NCMPR
20850 0FE6 BD 04E6           JSR    EXPR
20860 0FE9 DF 34             STX    BASPNT
20870 0FEB 8D 4A             BSR    CMPR
20880 0FED 24 03             BCC    IF2
20890 0FEF 7E 0DDF           JMP    REMARK
20900 0FF2 DE 34     IF2     LDX    BASPNT
20910 0FF4 BD 079B           JSR    CCODE
20920 0FF7 EE 00             LDX    0,X
20930 0FF9 6E 00             JMP    0,X
```

```
20950 0FFB BD 0744 RELOP  JSR     SKIPSP
20960 0FFE 08              INX
20970 0FFF 81 3D           CMP A   #'=
20980 1001 26 03           BNE     RELOP0
20990 1003 86 00           LDA A   #0          =
21000 1005 39              RTS
21010 1006 E6 00   RELOP0 LDA B   0,X
21020 1008 81 3C           CMP A   #'<
21030 100A 26 13           BNE     RELOP4
21040 100C C1 3D           CMP B   #'=
21050 100E 26 04           BNE     RELOP1
21060 1010 08              INX
21070 1011 86 02           LDA A   #2          <=
21080 1013 39              RTS
21090 1014 C1 3E   RELOP1 CMP B   #'>
21100 1016 26 04           BNE     RELOP3
21110 1018 08      RELOP2 INX
21120 1019 86 03           LDA A   #3          <>
21130 101B 39              RTS
21140 101C 86 01   RELOP3 LDA A   #1          <
21150 101E 39              RTS
21160 101F 81 3E   RELOP4 CMP A   #'>
21170 1021 27 05           BEQ     REL44
21180 1023 C6 06           LDA B   #6
21190 1025 7E 0828         JMP     ERROR
21200 1028 C1 3D   REL44  CMP B   #'=
21210 102A 26 04           BNE     RELOP5
21220 102C 08              INX
21230 102D 86 05           LDA A   #5          >=
21240 102F 39              RTS
21250 1030 C1 3C   RELOP5 CMP B   #'<
21260 1032 27 F4           BEQ     RELOP2
21270 1034 86 04           LDA A   #4          >
21280 1036 39              RTS



21300 1037 96 4F   CMPR   LDA A   NCMPR
21310 1039 48              ASL A
21320 103A 48              ASL A
21330 103B CE 1051         LDX     #CMPR1
21340 103E DF 20           STX     INDEX1
21350 1040 9B 21           ADD A   INDEX1+1
21360 1042 97 21           STA A   INDEX1+1
21370 1044 BD 05E9         JSR     SUB
21380 1047 BD 0448         JSR     PULLAE
21390 104A A6 00           LDA A   0,X
21400 104C DE 20           LDX     INDEX1
21410 104E 4D              TST A
21420 104F 6E 00           JMP     0,X
21430              *   ******FOLLOWING MUST BE ON ONE PAGE******
21440 1051 27 16   CMPR1  BEQ     OKCMPR
21450 1053 20 12           BRA     NOCMPR
21460 1055 2B 12           BMI     OKCMPR
21470 1057 20 0E           BRA     NOCMPR
21480 1059 2B 0E           BMI     OKCMPR
21490 105B 20 F4           BRA     CMPR1
21500 105D 26 0A           BNE     OKCMPR
21510 105F 20 06           BRA     NOCMPR
21520 1061 27 04           BEQ     NOCMPR
21530 1063 2B 02           BMI     NOCMPR
21540 1065 2A 02           BPL     OKCMPR
21550 1067 0D      NOCMPR SEC
21560 1068 39              RTS
21570 1069 0C      OKCMPR CLC
21580 106A 39              RTS
```

```
21600 106B BD 0448 USER   JSR    PULLAF
21610 106E BD 02B2        JSR    PUSHX
21620 1071 DE 67          LDX    DUMMY
21630 1073 AD 00          JSR    0,X
21640 1075 BD 02C7        JSR    PULLX

21660 1078 39      DUMRTS RTS



21680 1079 BD 0448 INT    JSR    PULLAF
21690 107C C6 09   INT1   LDA B  #9
21700 107E E0 06          SUB B  6,X
21710 1080 5D      INT2   TST B
21720 1081 2F 08          BLE    INT4
21730 1083 BD 0578        JSR    LRIGHT
21740 1086 6C 06          INC    6,X
21750 1088 5A             DEC B
21760 1089 20 F5          BRA    INT2
21770 108B 6F 05   INT4   CLR    5,X
21780 108D BD 059F        JSR    NORMPA
21790 1090 7E 0448        JMP    PULLAF



21810 1093 BD 0448 SGN    JSR    PULLAF
21820 1096 A6 00          LDA A  0,X
21830 1098 27 DE          BEQ    DUMRTS
21840 109A 97 4A          STA A  TSIGN
21850 109C BD 0BDD        JSR    CLRACC
21860 109F 86 01          LDA A  #1
21870 10A1 A7 00          STA A  0,X
21880 10A3 A7 06          STA A  6,X
21890 10A5 7D 004A SGN3   TST    TSIGN
21900 10A8 2A CE          BPL    DUMRTS
21910 10AA 7E 0528 SGN33  JMP    NEGACC
21920 10AD 39      SGN4   RTS

21940 10AE BD 0448 ABS    JSR    PULLAF
21950 10B1 6D 00          TST    0,X
21960 10B3 2A C3          BPL    DUMRTS
21970 10B5 20 F3          BRA    SGN33



21990 10B7 BD 0448 RANDOM JSR    PULLAF
22000 10BA BD 0DA4        JSR    TSTZER
22010 10BD 24 05          BCC    RAND1
22020 10BF BD 043F        JSR    PUSHAF
22030 10C2 20 08          BRA    RAND1+8
22040 10C4 CE 0069 RAND1  LDX    #RANNUM
22050 10C7 6C 00          INC    0,X
22060 10C9 BD 0302        JSR    INDX
22070 10CC CE 10EF        LDX    #RANMUL
22080 10CF BD 0302        JSR    INDX
22090 10D2 BD 06D1        JSR    MPY
22100 10D5 BD 0448        JSR    PULLAF
22110 10D8 BD 0552        JSR    ALLEFT
22120 10DB E6 01          LDA B  1,X
22130 10DD A6 03          LDA A  3,X
22140 10DF A7 01          STA A  1,X
```

```
22150 10E1 E7 03             STA B   3,X
22160 10E3 6F 06             CLR     6,X
22170 10E5 BD 059F           JSR     NORMPA
22180 10E8 CE 0069           LDX     #RANNUM
22190 10EB 7E 02D2           JMP     STOREX
22200 10EE 08        RANMUL  FCB     $08,$37,$25,$41,$69,$00
      10EF 37
      10F0 25
      10F1 41
      10F2 69
      10F3 00
22210      10F4      ROBERT  EQU     *



22230 1102                   ORG     $1102
22240 1102 007E      ASTACK  RMB     18*7
22250 1180 0080      FORSTK  RMB     128
22260 1200                   ORG     $1200
22270      1200      FILE    EQU     *
22280 A048                   ORG     $A048
22290 A048 0100              FDB     PROGM
22300                        END
```

```
SYMBOL TABLE

INDEX1 0020  INDEX2 0022  INDEX3 0024  INDEX4 0026  SAVESP 0028
NEXTBA 002A  WORKBA 002C  SOURCE 002E  PACKLN 0030  HIGHLN 0032
BASPNT 0034  BASLIN 0036  PUSHTX 0038  XSTACK 003A  DATPNT 003C
DIMPNT 003E  PRCNT  0040  MEMEND 0044  ARRTAB 0046  KEYWD  0048
TSIGN  004A  EXP    004B  SIGDIG 004C  DECFLG 004D  TOGGLE 004E
NCMPR  004F  TNUMB  0050  ANUMB  0051  BNUMB  0052  LRNINE 0053
ROUNDV 0054  ONLOOP 0055  NORSGN 0056  XLONG  0057  MPYXX  0059
BASNUM 005B  AESTK  005D  FORPNT 005F  FORNOW 0061  VARPNT 0063
SBRPNT 0065  DUMMY  0067  RANNUM 0069  FORTMP 006F  SBRSTK 0075
LOAFLG 0085  BUFNXT 00AC  ENDBUF 00AF  BUFFER 00B0  PROGM  0100
INTER  0106  TOPNT  0109  STEPNT 0110  COMMAN 0112  GOLIST 0137
STOMSG 01B3  COMEND 01BA  IMPLET 01BB  FUNCT  01BD  FUNEND 01ED
RDYMSG 01F0  DELMSG 01FB  PGCNTL 0200  WHAT   0203  ERRMS1 020C
ERRMS2 0214  DEL    021E  KEYBD  0225  KEYBD0 022C  KEYBD1 022F
KEYBD2 0258  CNTLIN 025D  IEXIT  0263  OUT2H  0270  OUT4HS 0273
OUTCH  0276  INCH   027B  BREAK  0281  BREAK0 0289  BREAK1 0290
OUTPUT 0292  OUTNCR 0299  CRLF   02A0  CRLFST 02AA  CREND  02B1
PUSHX  02B2  PULLX  02C7  STOREX 02D2  STORE  02F0  INDX   0302
IND    0309  INDO   0313  OUTLIN 032A  PRINSP 0350  FINVAR 0358
FINV1  0360  FINV11 0386  FINV2  0388  FINV3  0394  FINV4  039B
FINV5  03A9  FINV6  03B0  FINV7  03BD  TSTV   03C1  TSTV1  03C9
TSTV11 03D4  TSTV2  03D6  TSTV3  03F9  TSTV31 03FF  TSTV33 03F2
TSTV34 03F3  TSTV4  03FD  TSTV44 0417  TSTV5  0422  TSTLTR 042A
TESTNO 0432  NONO   043A  YESNO  043C  PUSHAE 043E  PSHXPA 0445
PULLAE 0448  DEXATE 044E  DEXSEV 044F  DEXSIX 0450  DEXFIV 0451
DEXFOR 0452  INXATE 0457  INXSEV 0458  INXSIX 0459  INXFIV 045A
INXFOR 045B  OVRTST 045F  FIX    0467  FIXERR 0470  FIX2   0477
FIXEX  0494  FACT   049A  PAREXP 04B1  FACT2  04BC  FACT3  04C1
TERM   04C5  TERM0  04C7  TERM1  04D9  TERM2  04E5  EXPR   04E6
EXPR1  04FB  NEGOP  0517  NEG    051F  NEGACC 0528  NEGA11 0532
NEGA2  0542  ALLEFT 0552  LLEFT  055D  LLEFT2 0563  LLEFT3 056C
LRIGHT 0578  LRIGH2 0584  LRIGH3 058A  NORMPA 059F  NORM   05A1
NORM00 05B5  NORM1  05BB  NORMEZ 05C5  NORMEX 05C7  NORM01 05D4
NORME0 05E4  NORME1 05EB  NORME2 05F3  SUB    05F9  ADD    05FC
ADD0   0611  ADD1   0622  ADD2   0624  ADD4   0629  SWAP   062C
SWAP1  0632  SWAP2  0640  ADDER  0645  ADDER1 064C  DIV    0659
DIV2   0678  DIV3   0679  MDSIGN 06A8  MDS2   06B5  MDS3   06C1
MDS4   06CF  MPY    06D1  MPY4   06E3  MPY5   06EA  MPY6   06F3
MDEXIT 06FE  MDEX2  0713  FINDNO 0716  FINDN1 0720  FINDO  0722
HIBALL 073E  SKIPSP 0744  INXSKP 074A  LINENO 074F  LINEO  0753
NXTLIN 077D  FCODE  0789  CCINT  0792  CCODE  079B  LOOP3  07A4
LOOP5  07B6  CCEXIT 07D3  FUNCEX 07D9  NEWSUB 07DC  START  07F2
READY  07F6  NEWLIN 0807  ERROR  0828  ERROR2 0853  RUN    085B
CLIST  0882  CLIST3 08A8  CLIST4 08BC  CLIST5 08C2  CLEXT  08D0
PATCH  08D3  SAVE   08E5  SAVE1  08F2  SAVE5  0903  LOAD   090D
APPEND 0910  LOAD1  0917  DELAY2 0933  DELAY  0935  DELAY3 0937
LEADER 093E  NUMBER 0949  NUM1   094C  DELREP 0964  REPLAC 0977
```

```
NEXIT   097B  CAPPEN  097C  DELETE  0984  DEL2    098F  DEL4    099D
DELEX   09A7  INSERT  09AA  INS2    09D2  BUFWRT  09DC  OVERFL  09F8
BASIC   0A00  THEN    0A29  ONERR   0A36  ONGO    0A3B  GOSUB   0A5A
GOSUB1  0A6E  GOTO    0A7C  GOTO1   0A81  GOTO2   0A9D  RETURN  0AA2
STOP    0AB6  INPUT   0AC4  INPERR  0ACA  INPUT1  0AD7  INPUT2  0AF0
INPUT4  0AF6  INPUT5  0B01  INPEX   0B0D  DBLLTR  0B18  INNUM   0B1D
TSTN    0B28  INNUM0  0B2B  INTST1  0B3F  INTST2  0B53  INTST3  0B6F
INTST4  0B70  INTST5  0B85  INTS55  0B8B  INTST6  0B8F  INTS66  0B98
MAYEXP  0B9D  MAYEX2  0BAA  INTST8  0BBB  INTST9  0BBF  INNEX   0BC3
CLRACC  0BDD  FORMEX  0BF2  INNER   0BF9  READ    0C17  READ1   0C19
READ2   0C26  RDERR   0C32  READ3   0C37  READ33  0C42  READ4   0C4D
READEX  0C5D  RESTOR  0C64  RESTO1  0C6A  PRINT   0C6D  PRINT0  0C6F
PRINT1  0C77  PRINT2  0C86  PRINT4  0C8A  PRINT5  0C9C  PRINTE  0CA2
CHR     0CA5  CHR2    0CAA  PRINT6  0CAD  TAB     0CB2  PRIN77  0CBB
PRINT8  0CC3  PRIN88  0CC8  PRLOOP  0CD0  PRIN99  0CDD  PRI999  0CE2
PREND   0CE5  OUTPNT  0CED  OUTZER  0CF1  OUTDIG  0CF2  OUTCHA  0CF6
ENLINE  0CFB  ENLEXT  0D0F  PRN     0D13  PRN0    0D1F  PRN1    0D25
PRN2    0D30  PRN3    0D43  PRN4    0D4D  PRN44   0D52  PRN5    0D63
PRISC1  0D67  PRISC2  0D83  PRISC3  0D84  PRTAIL  0D95  PRTAEX  0DA3
TSTZER  0DA4  TSTZ1   0DAC  TSTZ3   0DB7  LET     0DBC  LET0    0DC3
LET00   0DC5  LET2    0DD0  REMARK  0DDF  GETPAR  0DE4  GETPA2  0DEC
DIM     0E06  DIMERR  0E0F  DIM1    0E14  DIM3    0E29  DIM4    0E2A
DIMCAL  0E41  SUBCAL  0E59  SUBERR  0E5C  SUBC1   0E61  SUBC4   0E71
SUBC5   0E76  SUBC6   0E7E  SUBC7   0E7F  FOR     0E86  FOR1    0E90
FOR10   0EA2  FOR12   0EBF  FOR14   0EC6  FOR11   0ED0  FOR2    0EE6
FOR3    0EE9  FOR4    0F1B  FOR5    0F29  FOR7    0F33  FOR8    0F3A
NEXT    0F50  NEXT1   0F5A  NEXT2   0F72  NEXT3   0FBC  NEXT4   0FBF
NEXT5   0FD4  NEXT6   0FD8  IF      0FDD  IF2     0FF2  RELOP   0FFB
RELOP0  1006  RELOP1  1014  RELOP2  1018  RELOP3  101C  RELOP4  101F
REL44   1028  RELOP5  1030  CMPR    1037  CMPR1   1051  NOCMPR  1067
OKCMPR  1069  USER    106B  DUMRTS  1078  INT     1079  INT1    107C
INT2    1080  INT4    108B  SGN     1093  SGN3    10A5  SGN33   10AA
SGN4    10AD  ABS     10AF  RANDOM  10B7  RAND1   10C4  RANMUL  10EE
ROBERT  10F4  ASTACK  1102  FORSTK  1180  FILE    1200

READY
```

UNDERSTANDING UITERWYK'S BASIC

Introduction

The following Table 1, SUMMARY OF BASIC FEATURES, explains the characteristics of the 6800 4K BASIC Interpreter program. For convenience Robert Uiterwyk's 4K BASIC also carries the mnemonic name RU4KBASIC.

BASIC Program Format

A BASIC program is comprised of programming statements. These statements tell the computer in a step-by-step sequence how to perform a particular task. The computer has no intelligence of its own, and only understands what it has been programmed to do. The BASIC language has some simple but exacting rules on how to instruct a computer how to do a particular task. For instance, the format of a BASIC programming statement is always a statement number, followed by the statement body, and terminated by a carriage return. The statement body always starts with a keyword that identifies the type of statement.

Statements need not be entered in numerical order, because the BASIC interpreter will automatically sort the statements in ascending order by line numbers. The statement number is also used for reference purposes, as will be seen when discussing the GOTO, GOSUB and IF statements. All line numbers must be between 1 and 9999, and zero may not be used. A programming statement may con-

Table 1. Summary of BASIC Features

COMMANDS	*STATEMENTS*		*FUNCTIONS*
LIST	REM	END	ABS
RUN	DIM	GOTO*	INT
NEW	DATA	ON. . .GOTO*	RND
SAVE	READ	ON. . .GOSUB*	SGN
LOAD	RESTORE	IF. . .THEN*	CHR
PATCH	LET*	INPUT	USER
	FOR	PRINT*	TAB
	NEXT	PATCH*	
	STOP	RETURN	
	GOSUB*		

*Flags statements that may be used in the direct mode (No statement numbers)

MATH OPERATORS		*RELATIONAL OPERATORS*	
−	Unary negation	=	Equal
*	Multiplication	<>	NOT equal
/	Division	<	Less than
+	Addition	>	Greater than
−	Subtraction	<=	Less than or Equal
		>=	Greater than or Equal

Line Numbers may be from 0001 to 9999

Variables	Simple variables	Single alphabetic or Single alphabetic and a single digit
	Arrays:	Single alphabetic
Backspace	Control-O	
Line delete	Control-X	
Panic Button	Control-C should bring Basic back to the READY mode regardless of what the BASIC user program is doing.	

tain no more than 72 characters including blanks. Unless within a character string and enclosed by quotation marks (“), blanks are *not* processed by BASIC, and their use is optional. With blanks, the statement is more readable, as can be seen in Example 1, but will require a slightly longer time to process. In addition typing blanks in the statements will require more memory for the storage of the program. Keep in mind, though, that program readability is very important; for if you cannot read it, you cannot modify or fix it! The only place in BASIC that blanks may not be used at all, is inside the various keywords and inside numbers. "12 34" is *NOT* the same as "1234".

In any one program, a line number may be used only once. A previously entered line may be changed by entering the same line

Programming Statement	Memory required
110 LET A = B + (3.5*5E2)	23 Bytes
110LETA = B + (3.5*5E2)	16 Bytes

Example 1. Statements with and without imbedded blanks.

number along with the desired new statement. Typing just a line number followed by a carriage return will delete that line.

It is strongly suggested that you use line numbers which are at least ten numbers apart. This will make it easier to add in statements between the original statements in case of omission, or if you desire to add additional features to an existing program. If you do wish to insert a statement between two others, you need only type a line number that falls between the other two. For example consider the following original BASIC program:

```
180 LET P = A*A*3.14
185 PRINT
```

in which it is desired to insert the following addition program statement

```
183 REM INSERT THIS LINE
```

with the resulting program becoming:

```
180 LET P = A*A*3.14
183 REM INSERT THIS LINE
185 PRINT
```

If it is desired to replace a statement, a new statement is typed that has the same line number as the one to be replaced. For example, typing the statement:

```
180P = (A*A)*3.14
```

would cause the example program to become:

```
180P = (A*A)*3.14
183 REM INSERT THIS LINE
185 PRINT
```

Each line is terminated by a carriage return. Only after the carriage return is typed will BASIC store the new statement in the proper sequence in its memory. If after typing a line and before typing the carriage return, you should change your mind, simply enter a "control-X" (Control key depressed and X key struck) to delete the line. Single character typing errors can be corrected by typing a "control-O" for a backspace. The computer will print either a left-arrow (←) or an underline (_) for each "control-O" pressed, and will backspace across the characters stored in the input buffer. The character displayed in response to a "control-O" will vary depending on the terminal used. If it is desired to stop a running program, or to terminate a LIST command, you should use the "control-C" character.

Variable Names And Data Formats

Now that you know how to enter a program, correct any mistyped lines, and how to stop a running program, we should probably find out how the "numbers" that control the program flow are referenced.

All numbers which can be changed during the execution of a program are called *variables*. Those numbers whose values cannot be changed other than by retyping a programming statement are called *constants*. Variables are referenced by a unique name given them by the programmer. A simple variable may be given a name of a single alphabetic *or* a single alphabetic character followed by a single digit 0 thru 9. Thus legal names for a simple variable are: A, B, Z0, Q5. Illegal names are 9, 5A, A34, AB. BASIC also has a type of variable known as an array. An array is defined as an ordered collection of numeric data known to BASIC under a single name. Any array may be given a name of a single alphabetic character, A to Z. BASIC allows the use of both the simple variable A and the array A in the same program.

Arrays are divided into columns (vertical) and rows (horizontal). Arrays may have one or two dimensions. For example:

1.01
2.11
3.22
4.34

is a one dimensional array while

6	5	4
3	2	1
0	9	8

is a two dimensional array.

Array elements are referenced by their column and row position. For instance, if the examples above were arrays A and Z respectively, 2.11 would be A(2); similarly, 0 would be Z(3,1). The references to array elements are called subscripts, and set apart with parentheses. For example P(1,5) references the fifth element of the first row of array P; 1 and 5 are the subscripts. In X(M,N), M and N are the subscripts.

The range of numbers that can be stored in a single element of an array, or in a simple variable is 1.0×10^{-99} to $9.99999999 \times 10^{99}$. There are nine digits of significance in this version of BASIC. There will be no radix or base conversion errors in this version of BASIC, because all numbers are stored internally in an exponential (floating point) base 10 format. All numbers are internally truncated to nine digits to fit this precision. Numbers may be entered and displayed in three formats: INTEGER, DECIMAL, and EXPONENTIAL. BASIC will automatically select the appropriate output format when executing a "PRINT" statement. Figure 3 identifies the three formats and gives examples.

INTEGER (NO DECIMAL POINT)
1 998 10 99999999
DECIMAL (FLOATING POINT NUMBERS)
.123456789 3.14 1.2E−99
EXPONENTIAL (SCIENTIFIC NOTATION)
10E99 −1.2345E76 1.2E−99
E99 REPRESENTS 10^{99} AND E−99 IS 10^{-99}
(E STANDS FOR EXPONENT)

Figure 3. Data Formats

Commands

Although most BASIC statements will have line numbers, it is possible to communicate in BASIC by typing certain types of statements without line numbers. This type of statements is called *commands.* A command is a BASIC statement that causes immediate action. In contrast, however, a typical BASIC program is entered into the computer by typing it a line at a time; later typing a command (RUN) to cause the computer to begin executing the program in accordance with the programming statements previously stored in the computer's memory. When BASIC is ready for you to type a command or is able to accept a programming statement for storage, the word "READY" is displayed on the terminal. After each such entry the system will prompt for an additional command or programming statement by displaying a "#". When a command is typed, the computer will take immediate action on that command, and when the command has completed it will again respond with the word "READY" and a "#".

This version of BASIC will understand seven different commands: NEW LIST RUN SAVE LOAD APPEND PATCH. Each of these seven commands are described in Table 2.

Command Name	**Description of Command**
NEW	The NEW command causes the current program to be erased. All working storage, internal pointers, and all variables will be reset. The effect of this command is to erase all traces of a program from memory and to start over.
LIST	The LIST command has several formats which can be used to cause all or selected portions of the current program to be displayed on your terminal. The lines are displayed in sequence with the lowest number first. The different LIST formats are as follows: LIST — will list the entire program from start to finish.

LIST 100	will list only line 100.
LIST 100,200	will list lines 100 thru and including line 200.
LIST 100,1	will cause the program to begin listing at line 100 and will continue through to the end of the program. This operation will occur any time the second line number is less than the first.

RUN	The RUN command causes the current program in memory to begin execution at the first statement number. RUN always starts with the lowest line number and will proceed in sequential order unless directed to do otherwise with a GOTO, GOSUB, ON, or IF statement.
SAVE	The SAVE command causes the current program to be saved in a reloadable format on either the SWTPC AC-30 cassette interface or on a TELETYPE papertape punch, or an equivalent device. The control characters necessary to control the recording and playback mechanisms are output along with the program. More complete details are given in LOAD.
LOAD	The LOAD command will first erase any program currently in working storage (as in the command NEW) and will then load a previously saved program. Control characters are output to control the reading mechanism. More complete details are given in APPEND.
APPEND	The APPEND command functions exactly like the LOAD command except that memory is not cleared prior to the load function.
PATCH	The PATCH command causes the computer to return to the MIKBUG operating system and outputs a carriage return, line feed, and an '*' on the terminal device. If no memory belonging to BASIC (addresses ________ to ________) and the program counter (addresses A048 and A049) are not changed, typing a "G" will restart BASIC with your program intact. The PATCH command may even be inserted as a programming statement with a line number in your program. When the PATCH statement is encountered, con-

trol is transferred to MIKBUG. Upon typing a "G", control will return back to the line that immediately follows the patch command.

Note: All seven of the control commands described above may also be used as programming statements, if the control statement is typed following a line number. As a BASIC programming statement their action will be suspended until the program executes them in sequence.

Caution: Using the NEW statement as an executable statement will cause your program to self-destruct!

Program Statements

Each program statement line begins with a line number which must be an integer between 1 and 9999. Statements may be entered in any order, but they will be executed in numerical order. Blanks, unless enclosed by quotation marks, are ignored. Program statements are limited to 72 characters including blanks. Nineteen types of program statements are allowed and are described in the following paragraphs. For your convenience the statements are listed in alphabetical order, rather than someone's "easy-to-learn" sequence. This will make it easier to use as a reference manual.

DATA The DATA Program statement causes data to be stored as part of a program. This data will be used by a READ statement. Data statements do not execute; they merely specify data. Multiple data items in a data statement must be separated by commas. Data statements may be placed anywhere in a program, and will be read in sequence as required. When the data is read in a program, the data will be read in sequence from the first to last data statements, and from left to right within each data statement. Each data item may be read only once unless a RESTORE statement is executed. BASIC keeps track of data with a *pointer.* When the first READ statement is encountered, the pointer indicates that the first data item in the first data statement is to be used; the pointer is then moved to the second item of data, and so on. An example of the DATA program statement format is as follows;

```
100 DATA 123, 34.5, 695, 500
```

DIM The DIM Program statement allocates memory space for an array. In this version of BASIC, one or two dimensioned arrays are allowed. Maximum array size is 255 × 255 elements. (This is not as much of a limitation as you might think—you would need 393,216 bytes of memory to contain an array of 65535 elements! and this doesn't allow for any memory to store the program code. . .) All array elements are set to zero by the DIM statement. Dynamic re-dimensioning of arrays is not allowed. Once an array has been defined, it must not be re-defined in the same program. If an array is not explicitly defined by a DIM statement, it is assumed to be defined either as an array of 10 elements or as an array of 10 x 10 upon the first reference to it in a program.

An array can be allocated only once in a given program, implicitly and explicitly. Only the variables A thru Z (not followed by a number) may be dimensioned. This does not prevent the use of a simple variable of the same name.

The working size of an array may be smaller than its physical size. For example, an array declared 5 x 5 in a DIM statement may be used to store fewer than 25 elements; the DIM statement supplies only an upper bound on the number of elements. In the example of A(5,5) the first position of this array is A(1,1) and the last is A(5,5). An example of the DIM Program statement format is as follows;

```
    10 DIM A(5,5), Z(100,2)
```

END The END Program statement causes the program to stop executing. BASIC will print the word "READY" and a "#" on the terminal device indicating that it is now able to accept commands. In this version of BASIC, END may appear more than once and need not appear at all. It is recommended, however, that the last statement of a program be an END statement. This clearly shows that a program has been completely loaded or saved. An example of the END Program statement format is as follows;

```
    9999 END
```

FOR The FOR Program statement allows repetition of a group of statements within a program for a specified number of times. The variable name that follows the word 'FOR' is used to identify the related NEXT statement. In addition the variable is initially set to the value of the first expression (expression1). All statements between the FOR and the related NEXT statement are then executed. The named variable in the FOR statement is then incremented by the STEP value (expression3) and compared to the upper limit (expression2). If the increment creates a value that is *greater than* the upper limit (expression2) control of the computer is passed to the statement immediately following the NEXT statement. If the increment operation results in a sum that is equal to or less than the upper limit, the programming statements that fall between the FOR and NEXT statements will be repeated. This looping process will be continued until the upper limit has been exceeded, or as the result of an IF statement, control is passed to a statement outside the scope of the programming loop. If no STEP value is specified, a value of +1 is assumed. The loop will be executed once, regardless of the value of the variable. Although expressions are permitted for the initial, final, and step values in the FOR statement, they will be evaluated only once, the first time the loop is entered. It is not possible to use the same indexed variable in two loops if they are nested. When the statement after the NEXT statement is executed, the variable is equal to the value that caused the loop to terminate, and not the TO value itself. The step size need not be an integer. For instance,

```
100 FOR N = 1 TO 2 STEP .01
```

is a valid statement which will produce exactly 100 loop executions, incrementing N by .01 each time. A negative step size may also be used, as seen below:

```
100 FOR Q1 = 100 TO 50 STEP - 2.5
```

Examples of proper FOR Program statement formats are as follows;

```
320 FOR K = 1 TO 300
•
•
•
500 FOR variable = expression1 TO
expression2 STEP expression3
•
•
•
760 FOR L9 = 200 TO 1 STEP -1
```

See the description of NEXT statement for additional information.

GOSUB The GOSUB program statement causes the program to transfer control to the subroutine at the specified line address and returns to the line immediately following GOSUB XXXX. A subroutine is a sequence of instructions which performs a task that has use in more than one place in a program. To be able to use such a sequence of programming statements, BASIC provides the facility (GOSUB) to call upon such a sequence from more than one place in the program.

The subroutine is actually a sequence of instructions that will receive control upon the execution of a GOSUB statement. Upon completion of the subroutine, control is returned back to the mainline of the program by execution of a return statement. The statement that immediately follows the original GOSUB statement will receive control when the RETURN is executed.

Subroutines may be nested to a level of 8 deep. That is, one subroutine may call a subroutine, which can call a subroutine,. . . to a nested depth of 8 subroutines. An example of the GOSUB program statement format is as follows;

```
235 GOSUB 9010
```

GOTO The GOTO Program statement transfers control of the computer to the statement number specified. Program control will continue sequentially from the new statement. An example of the GOTO program statement format is as follows;

```
100 GOTO 375
```

IF The IF Program statement transfers control to a specified statement if the result of a conditional comparison is true.

The IF statement is used to control the sequence of program statements to be executed, depending on specific conditions. If the relational expression is true, then control is given to the statement or statement number declared after the THEN. If the relational expression is false, program execution continues at the statement that immediately follows the IF statement. The possible relational operators for use with the IF statement are as follows;

=	Equal
<>	Not equal
<	Less than
>	Greater than
<=	Less than or equal
> =	Greater than or equal

If a BASIC statement is specified after the THEN condition, rather than a statement number, the statement specified will be executed if the conditional expression is true, and control will be passed to the statement immediately following the IF statement.

It is possible to code another IF statement as the statement following the THEN condition—. This will give the equivalent of an "AND" condition.

When evaluating relational expressions, arithmetic operations take precedence in their usual order, and the relational operators are given equal weight and are evaluated last.

Examples of proper IF program statements formats are as follows;

```
190 IF X=56 THEN 300
•
•
•
200 IF Z9 D+Y-(7*S) THEN PRINT Z9;
"is out of range"
•
•
•
2022 IF expression1 relational-test ex-
pression2 THEN basic-statement
•
•
•
2022 IF expression1 relational-test ex-
pression2 THEN statement-number
```

An example of A program to illustrate IF statements is as follows:

```
10 INPUT X
20 IF X=1 THEN PRINT "EQUAL TO 1"
30 IF X<>1 THEN PRINT "NOT EQUAL
   TO 1"
40 IF X<1 THEN PRINT "LESS THAN
   1"
```

```
 50 IF X>1 THEN PRINT "GREATER
    THAN 1"
 60 IF X<=1 THEN PRINT "LESS THAN
    OR EQUAL TO 1"
 70 IF X>=1 THEN PRINT "GREATER
    THAN OR EQUAL TO 1"
 80 PRINT
 90 GOTO 10
100 END
```

INPUT The INPUT program statement allows users to enter data from the terminal during program execution and to assign that value to a variable. The variable specified may be either a simple variable or a specified element in an array.

When the program comes to an INPUT statement, a question mark is displayed on the terminal. The user then types in the requested data separated by commas and followed by a carriage return. If no data is entered, or if the data entered is insufficient, the system prompts the user for more data with an additional question mark. Only numerical constants can be given in response to an input statement. Any number of variables may be specified on the INPUT statement, within the confines of the 72 character line, and the user must respond with a value for each specified variable. An example of the INPUT program statement format is as follows;

```
100 INPUT A,C,D
```

LET The LET program or assignment statement is used to assign or specify the value of a variable. The value may be an expression, a number, or another variable. The keyword LET is optional, and need not be specified. There are four functions which may be used inside a formula on a LET statement. ABS (absolute value), INT (integer value), RND (random number), and SGN (sign *not sine*) may be used inside formulas or LET statements or anywhere else that a mathematical expression is allowed. Examples of proper LET statement formats are as as follows;

```
100 X = 123.45
110 LET Z9 = INT(RND(0)*100)
120 T5 = (A*A)*3.14
```

```
•
•
300A(1,1) = X + P(M,N)
•
•
400Z(I) = X
```

NEXT The NEXT program statement is used to define the end of a "FOR. . . NEXT" loop. The variable specified in the NEXT statement identifies the associated FOR statement. Multiple FOR. . . NEXT statements may be used in the same program; They may also be nested (placed inside one another.) When nested, the innermost loop or loops must be wholly contained inside the outermost loop. The range must not overlap. An example of the NEXT program statement format is as follows;

```
220 NEXT K
```

Figure 4, illustrates proper and improper nesting.

PROPER NESTING:

```
100 FOR I = 1 TO 20
      •
      •
      •
150 FOR J = 1 TO 2


170 NEXT J
      •
      •
      •
210 NEXT I
```

Innermost loop is contained totally within the outermost loop.

IMPROPER NESTING:

```
100 FOR I = 1 TO 20

150 FOR J = 1 TO 2
170 NEXT I
210 NEXT J
```

The loops overlap.

Figure 4. FOR. . . NEXT NESTING

For additional information see the description of the FOR statement.

ON

The ON program statement provides a computed GOTO or GOSUB mechanism. Instead of specifying the programming sequence of:

```
10 if X=1 THEN 100
20 if X=2 THEN 200
30 if X=3 THEN 300
40 if X=4 THEN 400
```

You could have used the following statement;

```
10 ON X GOTO 100,200,300,400
```

The computer would evaluate X, truncate the resulting value to an integer value, would then select the "Xth" statement number in the list of line numbers, and would use that value as part of a "GOTO" statement. Control of the computer would then be received by the selected line number.

In the example given above if the value of X was between 3 and 3.99999999 then the computer would GOTO 300. If the value of X was 1 then the computer would "GOTO 100". If the value of X is less than 1, or greater than the number of items in the list, the computer will generate an error message, and program execution will stop.

ON X *GOSUB* 100,200,300,400 works in a similar manner, except that the specified line numbers are assumed to be the start of a subroutine. When a RETURN statement has been executed, control on the computer will be returned to the statement immediately following the "ON X GOSUB" statement.

Note: The value X in the examples above can be any formula or mathematical expression.

(Additional note for FORTRAN Programmers or individuals trying to convert FORTRAN to BASIC):

> The FORTRAN IF statement can be simulated in BASIC thru the use of the ON . . . GOTO statement.
>
> FORTRAN: IF (X-Y)20,50,10
>
> BASIC: ON SGN(X-Y)2 GOTO 20,50,10

PRINT

The PRINT program statement causes the values of any variables specified in the PRINT statement to be output or printed on the terminal device. The PRINT statement can also be used to print out text, by enclosing the desired text to be printed in quotation marks ("). The statement

100 PRINT "HI THERE, I AM A COMPUTER"

would cause the text "HI THERE, I AM A COMPUTER" to be printed on the terminal device (the quotation marks would not be displayed or printed.)

The PRINT statement also makes use of the comma (,) and semicolon (;) to control the formatting of a print line.

In the statement PRINT A,B the numerical value of A will be printed beginning in the left hand margin, and the numerical value of B will be printed in column 18. Basic defines the 72 column line width into 4 zones starting in columns 18,36,48, and 60. The use of a comma in between data items will cause the printing mechanism to be advanced to the start of the next zone. This feature allows you to prepare tabular table data easily. The semicolon disables this "advance to next zone" mechanism and will cause the data items to be printed one after another. Numeric values will be separated by a blank for readability.

In addition if the PRINT statement is terminated by a semicolon, the computer will suppress the normal "carriage return, line feed", that is, automatically output at the end of each line. PRINT statement used with no operations or data items will cause a single blank line to be output.

This version of BASIC supports two special functions (TAB & CHR) that can be used only on the PRINT statement. The TAB function can be used to format items starting in columns other than 18,36,48, and 60. The CHR function is used to create special control characters that may not be generatable from your keyboard.

READ The READ program statement is similar in function to the INPUT statement except that the next DATA item is read, rather than getting a numeric value from the terminal. READ statements cause values in the DATA buffer to be accessed in a left to right, top to bottom sequential manner and assigned to the variable named in the read statement. If more than one variable is named in the READ, the values read from the DATA statements will be assigned, in the order read to the variables named on the READ staement. For additional information, see the description of the DATA and RESTORE statements. Examples of proper READ Program statement formats are as follows;

```
100 READ A
200 READ a,q9,B
```

REM The REM program or remark statement allows insertion of a line of remarks or comments in the listing of a program. REM Lines are saved as a part of a BASIC Program, and are printed when the program is listed, but they are ignored when the program is executing. An example of the REM program statement is as follows;

```
300 REM
```

RESTORE In the discussion on the DATA and READ statements, it was stated that once a data item was read, it could not be re-read. This is only partially true. The RESTORE program statement is used to reset the internal data pointer that BASIC uses, back to the first data item on the first data statement. Thus the entire data list may be re-read from the beginning.

The only way that you can re-read a particular data item, is to keep track of how far down the data list it is; RESTORE the data pointer, and then READ "n-1" numbers throwing all of the previous numbers away. The data pointer has now been "reset" to a particular data item, so that it can be reread. . . clearly not a very practical technique for most programs!!! An example of the RESTORE program statement format is as follows;

```
500 RESTORE
```

RETURN The RETURN Program statement is used to define the logical end of a subroutine, and when executed will cause control of the computer to be transferred to the statement immediately following the *last* GOSUB executed. A subroutine may call a subroutine, which calls still another subroutine. This may be done to a nested level of 8 deep. You must take care not to execute a return statement unless you have executed a GOSUB first. An example of the RETURN Program statement format is as follows;

```
1000 RETURN
```

STOP The STOP program statement operates in a similar fashion to the END statement; both cause the currently running BASIC program to stop running. The STOP statement, however, will identify the line number of the statement that caused the stop; while the END statement merely stops the program without identifying where the "end" occurred. This feature of the STOP statement makes it useful in identifying "error" conditions. For instance, in the following example the computer will print "STOP at 100" if the number typed in response to the INPUT statement is less than zero.

```
90 INPUT X
100 IF X<0 THEN STOP
```

An example of the STOP Program statement format is as follows;

```
900 STOP
```

FUNCTIONS

The following functions are available in Robert Uiterwyk's 4K 6800 BASIC.

ABS(x) The ABS or absolute function will take the absolute value of the expression x. If the value of the expression is a negative number then the value return by the absolute function will be a positive value. A positive value will remain a positive value.

if Z9 is a −32 then the ABS(Z9) will be a +32

if Q5 = +6 then the formula ABS(Q5 + 3) will return a value of +9.

INT(x) The INT or integer function is used to truncate or "chop-off" any decimals in a floating point number. Positive values will be chopped off to the next lower integer, and negative numbers will be rounded up to the next lower value.

INT(9.765) will result in a value of 9.

INT(−10.2) will result in a value of −11.

RND(x) The RND or random number generator generates a pseudo-random number ranging

	between 0.0 and 1.0. If the argument (x) is not equal to zero, it will be used as a new seed for the random number generator. The value returned as the result of specifying a new seed should be ignored. A new random number will be received when the argument specified is zero. In this version of BASIC it is not necessary to seed the generator in order to start a new random series of numbers at the start of a game.
SGN(x)	The SGN Or sign function returns a −1, 0, or +1 value depending on the magnitude of the expression (x). If x is less than zero, the SGN will return a value of −1. If x is equal to zero, SGN will return a value of zero. If x is greater than zero, SGN will return a +1 if Z9 is a −45.987 then SGN(Z9) will be a −1 if Q is a +34.59 then SGN(Q) will be a +1 if R is a −10 and S is a −5 then SGN (R-2*S) will be 0.
CHR(x)	The CHR function is used to convert the value of X (which must be between 2 and 255) to a single ASCII character. Thus CHR(16) will create a "CONTROL-P" and CHR(22) will create a "CONTROL-U". The CHR function may be used only on the PRINT statement and is useful for creating special control characters required for terminal control.
TAB(x)	The TAB function can be used only in a PRINT statement. The value of X will cause the print mechanism to be positioned at column X. TAB(10) will cause a tab to column 10, TAB(50) will cause a tab to column 50. The value of the TAB function must be from 1 to 72.
USER	The USER function is used to call a user defined assembly language subroutine.

OPERATORS

Symbols used to instruct the microcomputer to perform some operation are called operators. This version of BASIC includes arithmetic and relational operators.

ARITHMETIC OPERATORS—Five standard BASIC arithmetic operators are provided with this versin of BASIC. The arithmetic operators are as follows:

–	Unary negation
*	Multiplication
/	Division
+	Addition
–	Subtraction

RELATIONAL OPERATORS—Standard BASIC relational operators are provided for comparing the values of integer expressions. The relational operators are as follows:

=	Equal
<>	Not equal
<	Less than
>	Greater than
<=	Less than or equal
>=	Greater than or equal

ERROR MESSAGES

The following error messages can be created by BASIC at any time:

ERROR CODE	MESSAGE DESCRIPTION
1	OVERSIZED VARIABLE. A TAB, CHR, ON or subscript value was greater than 255.
2	INPUT ERROR.
3	ILLEGAL CHARACTER OR VARIABLE. An illegal variable name of an invalid character was found during the evaluation of a mathematical expression.
4	NO ENDING " IN PRINT LITERAL. A missing quotation mark was detected in a print statement. There must be an even number of quotation marks on a print statement. The character (") cannot be output as a text character except by specifying CHR(34).
5	DIMENSIONING ERROR. Only two dimensions are allowed, and must be a value between 1 and 255. Once defined an array may not be defined again. Place all DIM statements at the start of the program, where they can not be accidentally executed a second time. All references to an array which is defined on a DIM statement must occur after the DIM statement has been executed.
6	ILLEGAL ARITHMETIC. The most common cause of "illegal arithmetic" is two arithmetic operators following each other, without a

numeric value separating them. "2+ −3" is illegal arithmetic.

7 LINE NUMBER NOT FOUND. The "GOTO", "GOSUB" or "IF. . .THEN" line number does not exist in the program. If necessary a REM statement may be used as a dummy line to resolve a missing line number.

8 DIVIDE BY ZERO ATTEMPTED. You just can't do it! If there is no way to prevent it, place an "IF" statement prior to the divide and branch around the divide statement if a divide by zero might occur.

9 EXCESSIVE SUBROUTINE NESTING. The maximum number of subroutines that may be nested is 8. Generally when this occurs it is because a GOSUB is accidentally being executed, or somehow a return statement has not been executed.

10 RETURN without PRIOR GOSUB. You executed a RETURN statement without first executing a GOSUB. This is a no-no.

11 ILLEGAL VARIABLE. The name for the variable is not correct. An array may only be named with a single alphabetic character. A(1) is correct, A5(1) is not. A simple variable may be named either with a single alphabetic character, OR a single alphabetic character followed by a single numeric character. A, B0, C1 are legal names. 1A, BB, C3A are not legal names. This version of BASIC does not support character string variables (A$, B$, etc.)

12 UNRECOGNIZABLE STATEMENT. This first word in the statement was not a recognizable COMMAND or BASIC statement name; nor was it a variable (simple or array) name followed by an equal sign (=). This latter case is known as an implied LET statement.

13 PARENTHESIS ERROR. Either you have too many opening parenthesis "(" or too few closing ones ")". There must be exactly the same number of opening and closing parenthesis in a programming statement.

14 MEMORY FULL. You just ran out of memory. Try to reduce the number of variables used in the program. If arrays are being used make

sure that they are dimensioned to the exact size required. Reduce the amount of remarks and the amount of PRINT statements used. Look and see if any routines are similar enough in nature to be made a subroutine. Look for more efficient algorithms to solve your problem. Split the program up into several different programs. If all else fails, go buy some more memory!

15 SUBSCRIPT ERROR. The array was defined as a one dimensional array and the reference contains two dimensions, or vice-versa.

16 EXCESSIVE FOR LOOPS ACTIVE. The maximum number of nested FOR...NEXT loops is 8.

17 NEXT WITHOUT CORRESPONDING FOR. A NEXT statement has been found without a corresponding FOR statement. The named variable that occurs after the word "FOR" and after the word "NEXT" is used to identify corresponding "FOR" and "NEXT" statements.

18 MISNESTED FOR NEXT LOOPS. The computer has detected an improper nesting for multiple "FOR...NEXT" statements. See Figure 3 for an explanation of the proper and improper way to nest "FOR...NEXT" statments.

19 READ STATEMENT ERROR. Read statement was executed, and there is not enough data in the data buffer to satisfy the READ request.

20 ERROR IN ON STATEMENT. The expression when truncated to an integer value resulted in either a value less than one, or in a value that is greater than the number of statement numbers in the list. In the example below an error 20 will occur if the value of (X-Y) is less than 1 or greater than 5.

```
100 ON(X-Y) GOTO 1000,235,3000,20,35
```

21 INPUT OVERFLOW. More than 72 characters were typed on the line.

GRAMMAR REFERENCE SUMMARY

Table 3, Quick definition of BASIC Statements, and Table 4, BASIC functions, provide a quick reference for using, Robert Uiterwyk's 4K 6800 BASIC Interpreter.

Table 3. Quick definition of BASIC Statements

STATEMENT	DEFINITION	RELATED STATEMENT(S)
DATA	'STORES' DATA TO BE USED BY READ STATEMENT	READ RESTORE
DIM	DEFINES SIZE OF AR— RAYS (1 or 2 dimensions are allowed.)	
END	DEFINES END OF PROGRAM	STOP
FOR	DEFINES START OF PROGRAMMING LOOP	NEXT
GOSUB	TRANSFERS CONTROL TO A SUBROUTINE	RETURN
GOTO	TRANSFERS CONTROL TO OTHER THAN THE NEXT SEQUENTIAL STATEMENT	
IF	CONDITIONAL TEST USUALLY USED TO TRANSFER CONTROL "IF"	THEN
INPUT	GET DATE FROM KEYBOARD OF ATTACHED TERMINAL	
LET	ASSIGNMENT OF CALCULATION STATEMENT	
NEXT	DEFINES END OF PROGRAMMING LOOP	FOR
ON	COMPUTED "GOTO" OR "GOSUB"	GOSUB GOTO
PRINT	PUT DATA TO PRINTER OR CRT OF ATTACHED TERMINAL	
READ	GET DATA FROM "DATA" STATEMENTS	DATA RESTORE
REM	PROGRAMMER'S COMMENT	
RESTORE	RESETS THE DATA POINTER IN "DATA" STATEMENT	DATA READ
RETURN	DEFINES END OF SUBROUTINE — CAUSES CONTROL TO BE TRANSFERRED BACK TO STATEMENT IMMEDIATELY FOLLOWING THE GOSUB STATEMENT	GOSUB

STOP	DEFINES THE END OF THE PROGRAM: AND IDENTIFIES THE STATEMENT NUMBER OF THE STOP.	END

Table 4. BASIC Functions

ABS( )	ABSOLUTE VALUE
CHR( )	CONVERSION OF VALUE TO A SINGLE CHARACTER
INT( )	INTEGER VALUE (TRUNCATES DECIMAL VALUE)
RND( )	RANDOM NUMBER GENERATOR; RETURNS VALUE FROM .000001 to .999999
SGN( )	SIGN OF X; RETURNS A + 1, 0, or – 1
TAB( )	USED IN PRINT STATEMENT ONLY; CAUSES A TAB TO THE SPECIFIED COLUMN
USER( )	CAUSES A CALL TO A USER DEFINED ASSEMBLY LANGUAGE SUBROUTINE

Appendix A

General Software Index

Compiled by Jim Schreier

The software published in *Interface Age* between December 1976 and December 1978 is rich and varied. Historically, this time period marked the apex of "hobbyist" software and the dawning of "business" programs. Generally, the 1977 pages of *Interface Age* contained assembled programs for the SC/MP, 6800 and 8080. The 1978 edition published software for a wider variety of chips plus BASIC, FORTRAN and PILOT programs. This variety of subject matter will interest most microcomputer users as well as provide a permanent record of excellent software.

This compilation is divided into two sequential sections: Software by High Level Language and Software by CPU chips.

The High Level Languages are in alphabetical order by the name of the BASIC. Most users will want to see what programs were published for their specific microcomputer. The term "GENERAL BASIC" means the documentation failed to identify a specific BASIC dialect. Of course, there is no such thing as a "General BASIC," yet. It is possible to translate one BASIC to another given enough time.

Likewise, the assembled software is arranged by CPU chips in numeric order. Some of the most important published software programs appear in this section. Foremost is the publication in four parts of the Livermore BASIC Interpreter.

ALTAIR BASIC v 4.0 Building and land development program
BASIC listing November 1978 p 88

ALTAIR Extended BASIC v 3.2 Computer(ese) speech writer
BASIC listing January 1978 p 150

ALTAIR Extended disk BASIC v 4.0 Number base conversion
2 BASIC listings for disk and non-disk applications May 1977 p 116

ALTAIR 8K BASIC v 3.2 Star Lanes
Fixes to the computer game October 1977 p 8

ALTAIR 8K BASIC v 3.2 Star Lanes
Computer game requiring 7K bytes June 1977 p 137

APPLE BASIC APPLE Star-Trek
small BASIC listing May 1977 p 134

APPLE BASIC LOGAN
BASIC listing for logic circuit analysis May 1977

APPLE II BASIC Automated dress pattern
floppy ROM™-2 BASIC and assembled listings September 1978 p 78 and 80a

APPLE II BASIC TV pattern generator
BASIC listing August 1978 p 160

BASIC-E Membership file maintenance
illustrating random disk files February 1978 p 159

BURROUGHS B6700 BASIC Machine Menace
artificial intelligence game March 1977 p 22

CBASIC Personal management program
CBASIC compiler listing August 1978 p 79

COMPUCOLOR BASIC European Roulette in color—game
BASIC listing August 1978 p 57

FORTRAN IV M6800 cross assembler
2 pass cross assembler with symbol table October 1977 p 152

FORTRAN IV M6800 cross assembler
erratum December 1977 p 134

GENERAL BASIC Aquarium maintenance
calculates 11 items December 1977 p 66

GENERAL BASIC ASCII control character program
BASIC listing February 1978 p 8

GENERAL BASIC Base number conversion
converts base 2-8-10-16 November 1977 p 161

GENERAL BASIC Bi-lingual math tutoring
English and Spanish BASIC listings September 1978 p 131

GENERAL BASIC Biorhythm—plotting game
corrected listing December 1977 p 144

GENERAL BASIC Biorhythm—plotting game
2 listings with 1 designed for BASICs without SIN function
October 1977 p 142

GENERAL BASIC Circuit analysis
BASIC listing August 1978 p 118

GENERAL BASIC Financial analysis program
calculates annuity-lump sum and bonds March 1978 p 55

GENERAL BASIC Function approximation with 2 variables
BASIC listing October 1978 p 77

GENERAL BASIC Harmonic analysis of point sources
noise analysis program October 1977 p 54

GENERAL BASIC Job costing with random numbers
based on number of trials December 1977 p 86

GENERAL BASIC Local mean time
difference between GMT and T calculated August 1977 p 32

GENERAL BASIC Local sidereal time and date
6 various time/date calculations August 1977 p 33

GENERAL BASIC Pico fumi—game
BASIC listing December 1978 p 141

GENERAL BASIC Play number—child's game
BASIC listing September 1978 p 129

GENERAL BASIC Pot roast cooking time
a sample BASIC listing December 1977 p 33

GENERAL BASIC Preprocessor for structured programming
BASIC listing February 1978 p 85

GENERAL BASIC Stop TV display routine
BASIC listing June 1978 p 155

GENERAL BASIC Urine sugar and insulin curve plot
BASIC listing December 1978 p 73

HEWLETT PACKARD BASIC Viking uplink/downlink
communications between earth and Mars on Viking I August 1977 p 78

HONEYWELL 1108 Random number program for security combinations
calculates 3 number series December 1977 p 148

IMSAI BASIC Business risk simulation
BASIC listing January 1978 p 91

IMSAI BASIC Business risk simulation
BASIC listing January 1978 p 91

IMSAI 12K Extended BASIC v 4.0 Injun Poker—game
4K BASIC listing December 1977 p 162

MICROSOFT BASIC Recovery of crashed TARBELL tapes
BASIC listing April 1978 p 149

MITS 8K BASIC Azimuth by celestial observations
BASIC listing August 1978 p 76

MITS 8K BASIC Checkers
BASIC listing with graphics March 1977 p 136

MITS 8K BASIC v 3.1 Crazy ball
video game for Polymorphic VTI board August 1977 p 171

MITS BASIC v 3.1 Base number conversion
converts base 2-split octal-8-10-16 November 1977 p 163

MITS BASIC v 4.0 Bowling
A Bowling simulation for 4 players July 1977 p 170

MITS BASIC v 4.0 General Payroll
10 programs using random files June 1977 p 108

MITS BASIC v 4.0 Household finance system
includes monthly and yearly reports December 1977 p 46

MITS BASIC v 4.0 Tic-Tac-Toe
program allows computer to lose once in a while August 1977 p 170

MITS Disk BASIC v 4.0 Heart attack probability
BASIC listing July 1978 p 58

MITS Disk BASIC Motel's General Ledger
(a) floppy ROM™ at 1200 baud September 1977 p 32A
(b) 14 listings November 1977 p 57

MITS Disk Extended BASIC v 4.0 Solar eclipse prediction
12K BASIC listing August 1977 p 43

MITS Disk Extended BASIC v 3.4 The word processor
floppy ROM™ with source code January 1978 p 32A and 75

MSI Disk BASIC Full function mailing list system
floppy ROM™ at 300 baud and BASIC listings May 1978 p 59 and 64a

NORTH STAR Disk BASIC 1040 tax calculation program
based on California tax tables January 1978 p 158

NORTH STAR Disk BASIC Crazy ball—game
BASIC listing January 1978 p 170

NORTHSTAR Disk BASIC Random access name and address retrieval
2 BASIC listings August 1978 p 104

NORTH STAR Disk BASIC The tax man—game
BASIC listing February 1978 p 140

PDP-10 BASIC BASIC cross assembler for the 8080
BASIC listing February 1978 p 79

PDP-10 BASIC Data base management system
BASIC listing August 1978 p 113

PDP-10 BASIC Hexapod
Robotic walking program June 1977 p 50

PILOT Animal guessing—CIA game
PILOT Listing September 1978 p 66

PITTMAN'S 6800 TINY BASIC Shooting Starts
2K BASIC games listing April 1977 p 110

PROCESSOR TECHNOLOGY 5K BASIC Microcomputer Stock Options
4.2K BASIC listing designed for a stock market hedge February 1977 p 37

SWTPC 8K BASIC v 1.0 Calculating the position of Venus
calculates degrees or hours from the sun August 1977 p 55

SWTPC 8K BASIC v 1.0 Checkbook balancing
BASIC listing May 1977 p 126

SWTPC 8K BASIC v 1.0 Day of the Week
BASIC listing from 1752 June 1977 p 128

SWTPC 8K BASIC v 1.0 Depreciation schedule analysis
BASIC listing of 4 types of depreciation September 1977 p 148

SWTPC 8K BASIC v 2.0 How to buy an apartment building
6 calculations supported January 1978 p 99

SWTPC 4K BASIC v 2.0 Resistor sorting
BASIC listing April 1978 p 167

SWTPC 4K BASIC v 2.0 Sine-Cosine-Exponential-Logarithm-Square Root-Algorithms February 1977 p 103

SWTPC 8K BASIC v 2.0 World power—game
BASIC listing February 1978 p 171

SWTPC 8K BASIC v 2.0 Zip code sort and print program
BASIC listing April 1978 p 91

TDL 8K BASIC Personal accounts payable
tape based program December 1977 p 59

2650 Interface design
5 assembled listings November 1977 p 87

6502 Robot control routines
assembled initialization program-speed control-joystick control-etc.
April 1977 p 24

6502 Search subroutine for the 6502 Disassembler
assembled listing: See *Interface Age* September 1976 p 14
October 1977 p 146

6502 Sidereal/Solar clock for KIM-1
assembled listing August 1977 p 37

6800 A better memory test
assembled listing with object code July 1977 p 160

6800 A faster TTY paper tape load and dump
2 assembled listings with object code September 1977 p 162

6800 Bubble sort routine
assembled listing with object code September 1977 p 156

6800 Darkroom prompter program
assembled listing October 1978 p 84

6800 EXMON—Extended monitor system
assembled listing with object code April 1977 p 115

6800 GP monitor
assembled 4K RAM listing plus object code for 4-8-16 and 32K
October 1978 p 133

6800 High density tape load
assembled source listing with object code August 1977 p 167

6800 High density tape punch
assembled source listing with object code August 1977 p 163

6800 IAPS™ International ASCII Publication Standard conversion
assembled listings for 3 versions May 1978 p 73

6800 MIKBUG™ Do Nothing—nonsense game
object code listing December 1977 p 111

6800 PIA test
assembled listing without comments with object code July 1977 p 162

6800 Program data or address locator
assembled listing with object code dump December 1978 p 137

6800 Prototype board monitor program with PROM burner
assembled listings February 1977 p 115

6800 Re-entrant self-relative subroutine ROM
assembled listing March 1977 p 129

6800 Relocator
assembled listing March 1978 p 166

6800 Software aid for firmware production
2 assembled listings March 1978 p 157

6800 Stars—a game
assembled listing with object code October 1977 p 161

6800 Text Editor
assembled listing December 1976 p 89

6800 Uiterwyk's 4K BASIC Interpreter
floppy ROM™ at 300 baud disk-object code listing with assembled binary loader May 1977 p 33

6800 Uiterwyk's 4K BASIC Interpreter: 3 routines
assembled MIKBUG™ jumps-ACIA break routine-biload command
July 1977 p 36

8080 2707 EPROM programming software
assembled listing December 1978 p 104

8080 A tabcounter for your edit buffer
assembled listing August 1978 p 151

8080 An 8080 binary tape monitor
assembled listing February 1978 p 153

8080 An Intel hex-format paper tape monitor
assembled listing March 1978 p 162

8080 Blockade—VDM-1 video game
assembled listing with object code November 1977 p 167

8080 Cassette Operating System
assembled subroutine listings April 1977 p 129

8080 Convert Motorola 6800 hex format to Intel format
assembled listing with object code May 1977 p 109

8080 Conway's Game of Life
assembled listing for Processor Technology's video display board
May 1977 p 138

8080 Copy/Sort/Search data manipulation
assembled listing September 1978 p 136

8080 Cromemco Dazzler graphics interface driver
assembled listing January 1978 p 153

8080 Diablo printer drive routine
assembled listing July 1977 p 25

8080 Dr. Wang's tiny BASIC
assembled listing December 1976 p 89

8080 Generalized string sorting routine
BASIC and 6 assembled listings November 1978 p 131

8080 I/O driver for PERSCI 1070 intelligent disk controller
assembled listing September 1977 p 153

8080 IAPS^{TM}International ASCII Publication Standard conversion
asembled listing May 1978 p 79

8080 IAPS^{TM} International ASCII Publication Standard conversion
assembled load-create-verify-dump listings June 1978 p 148

8080 Intel hex format paper-tape punch program
assembled listing with object code July 1977 p 155

8080 Intelligent terminal program
assembled listing with object code September 1977 p 75

8080 Interval timer design
5 assembled routines January 1978 p 127

8080 Intrupped driven floppy disk controller for the S-100 bus
assembled listing May 1978 p 152

8080 Livermore BASIC Interpreter Part I
BASIC and assembled plot functions December 1976 p 115

8080 Livermore BASIC Interpreter Part II
assembled listing January 1977 p 97

8080 Livermore BASIC Interpreter Part III
assembled floating point math package listing February 1977 p 104

8080 Livermore BASIC Interpreter Part IV
assembled octal debugging listing March 1977 p 121

8080 Look—byte look-up program
assembled listing May 1978 p 167

8080 Memory catalog program
assembled listing May 1978 p 170

8080 Memory object code search routine
assembled routine February 1977 p 121

8080 Monitor initialization and printer control
2 assembled Daisywheel listings October 1978 p 111

8080 Morse Code generator
assembled listing October 1978 p 89

8080 Octal Monitor Program
assembled listing February 1977 p 13

8080 Piranha—game
assembled listing with object code December 1977 p 166

8080 Polymorphic Ideaboard software
2 assembled routines May 1977 p 98

8080 Punch and read Intel formatted tape
assembled listing December 1977 p 152

8080 Random Number Generator Program
assembled listing with a BASIC Chi-square subroutine February 1977 p 100

8080 Robot's random programming approach
assembled listing April 1978 p 158

8080 Text editor for XEK and PTCo Assemblers
assembled listing October 1978 p 140

8080 Video Chase—a game
assembled listing with object code October 1977 p 167

8080A Resident Operating System
1K SOL assembled listing January 1977 p 90

9900 Interactive monitor
assembled listing July 1978 p 163

MOLYPROCESSOR Molyprocessor Music
assembled listing November 1977 p 153

SC/MP CRT Interface firmare
assembled listing January 1978 p 120

SC/MP Lock combinations program
assembled listing July 1977 p 44

SC/MP NIBL—Extended tiny BASIC
assembled listing January 1977 p 113

SC/MP Seiko printer interface and program
assembled listing May 1977 p 124

SC/MP Word G—a word game
assembled listing December 1977 p 136

Z-80 BYTEMOVER™ for Cromemco's BYTESAVER™
assembler listing January 1977 p 70

Z-80 Date and time for CP/M DOS
assembled listing August 1978 p 154

Z-80 Disk I/O keyboard handler
assembled listing September 1977 p 167

Z-80 Letter writing program
assembled listing September 1978 p 94

Z-80 Patches to the MITS 12K Extended BASIC
assembled routines March 1977 p 138

Z-80 Spaceship simulator
assembled service routine March 1978 p 74

Z-80 TTY handler for the Z-80 development system
serial and test assembled listings May 1977 p 112

Z-80 User I/O for LIFEBOAT CP/M™ DOS
assembled listing December 1978 p 133

Appendix B

Available Back Issues

April 1976	2.25
October 1976	2.25
November 1976	2.25
March 1977	2.25
May 1977	
June 1977	2.50
July 1977	2.50
August 1977	2.50
September 1977	2.50
October 1977	2.50
November 1977	2.50
February 1978	2.75
April 1978	2.75
July 1978	2.75
August 1978	2.75
September 1978	2.75
October 1978	2.75
November 1978	2.75
December 1978	2.75

March 1979	2.75
April 1979	2.75
May 1979	2.75
June 1979	2.75
July 1979	2.75
August/September 1979	2.75

INTERFACE AGE MAGAZINE Dept. BI P.O. Box 1234,
Cerritos, CA 90701

Name (print) ____________________

Address ____________________

City ____________ State ________ Zip ________

Price includes 50¢ for postage and handling.

VISA# ____________ M/C# ____________

Exp. Date ________ Signature ____________

Index

APPEND, 283

Bagels, 189
BASIC, 1, 139, 229, 278
BREAK, 183

CHKIO, 167
CHKSGN, 161
CKHLDE, 161
CLEAR, 184
Colons, 188
Commands, 282

DATA, 284
Data formats, 281
DIM, 284
DIRECT, 149
DIVIDE, 161
DO, 185

END, 188, 285
ENDCHK, 162
ERROR, 162
EXEC, 149
EXPR, 157
External Routine Calls, 245

FIN, 162
Floppy ROM, 229
FNDLN, 163
FOR, 154, 186, 285
FUNCTIONS, 294

GETLN, 163
GOSUB, 153, 183, 287
GOTO, 183, 287

IF, 287
IFF, 156
IF/THEN, 184
INP, 160
Input, 8
INPUT, 154, 186, 289
Interpreter, 8

Kansas City Standard, 230

LET, 156, 289
LIST, 153, 183, 188, 282
LOAD, 283

MAIN, 147
Math operator, 2
Memory map, 238
MIKBUG, 233
MVDOWN, 166
MVUP, 166

NEXT, 154, 186, 290
NEW, 184, 282
NIBL, 173

ON, 291
ONION, 174
OPERATORS, 295

OUT, 160
OUTC, 167

PAGE, 184
PATCH, 283
PEEK, 160, 182
POKE, 160, 182
POPA, 166
PRINT, 153, 186, 291
Program control, 183, 284
PRTLN, 164
PRTNUM, 164
PRTSTG, 164
PUSHA, 166

QTSTG, 164

READ, 262
REM, 156, 188, 293
RESTORE, 293
RETURN, 153, 184, 293
ROM, 229, 240
RUN, 183, 283

SAVE, 283
SETVAL, 162
Software, 301
STAT, 184
STOP, 294
SUBDE, 161

TABLES, 149
Tiny BASIC, 140, 146
Trap, 22
Truth, 191
UNTIL, 185
USR, 160

Variable names, 281

WAIT, 160

ISBN: 0-918398-36-3